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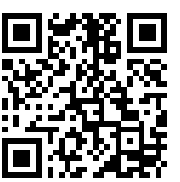

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VOLUME VIII.

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BRIDGING THE MEDWAY AT CHATHAM.

AN interesting piece of pontoon, barrel pier, and trestle bridging was carried out recently across the Medway at Chatham, under the direction of Bt. Lieut.-Colonel G. H. Fowke, R.E., the Instructor of Fortification. As no such work has been accomplished on so large a scale of recent years, the following details are published :—

1. *Site of Bridge.*—The site of the bridge (shown in *Fig.* 1 of the Litho Plate) was selected on account of the difficulties presented by the high river wall and mud on the Dockyard side.

The strong current (4 miles an hour), its rise and fall (14 feet), and the large amount of traffic afford useful instruction.

2. *General Design of Bridge.*—The bridge was designed to carry infantry in fours, weighing 5 cwt. per lineal foot of roadway, or 8,400 lbs. on each 15-foot bay. This allowance is sufficient for cattle, 18-pr. and 13-pr. guns, and 5-inch howitzers, but for the 60-pr. gun (owing to the concentrated nature of the load) double chessing would have to be adopted and the bays shortened to 10 feet, and an extra pontoon section introduced into each pier.

The width of the roadway was 9 feet in the clear.

The length of the bays was 15 feet, with the exception of the 2-pier barrel rafts, where it was 10 feet.

The width of the river at high water is 1,190 feet; an additional allowance of 14 feet has to be made for the difference in length at high and low water (adjustment by sliding baulks), which, together with a distance of 4 feet from the Dockyard wall, necessitates 1,208 feet of equipment.

3. *Detail of Bridge.*—The bridge was a composite one, consisting of a tidal ramp at each end, with a floating portion in between made up of pontoons and barrel piers, having a central cut of 180 feet—"Y" to "U"—to allow traffic to pass through.

Tidal Ramp, Dockyard Side.—"A" to "C" (*Fig.* 6).—Six composite trestles, 33 feet high, sunk 3 feet to 4 feet in mud—made specially for the purpose—having an adjustable road transom sliding between the two frames of the trestle, supported, raised, and lowered by chains and differential blocks (*Fig.* 2); length, 90 feet.

"C" to "D."—Three 4-legged trestles, resting at low water on the mud, and raised by four pontoons as the tide rises (*Fig.* 3); length, 60 feet.

"D" to "Z."—A ramp raft of three pontoons, the ramping being effected by building up chesses on to saddle beams; length, 30 feet.

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Floating Portion—"Z" to "Y" (*Fig.* 6).—Eleven 2-boat rafts (22 pontoons); length, 315 feet.

There were cut baulks at "Z" to allow the bridge to swing at this point when opening at the centre cut.

Between Nos. I. and II. rafts there were sliding baulks to compensate for difference in length of bridge at high and low water.

Central Cut—"Y" to "U."—Two 4-boat rafts and two 3-boat rafts (14 pontoons); length, 180 feet. "U" to "T."—Six 2-boat rafts (12 pontoons); length, 165 feet. Between Nos. XV. and XVI. rafts there were sliding baulks, and at "T," for swinging clear of barrel piers, cut baulks were provided.

"T" to "S."—Six 2-pier barrel rafts (*Fig.* 9), 84 108-gallon casks; length, 110 feet.

There was a cut at "S," allowing the whole of the barrel portion of the bridge to be disconnected.

Tidal Ramp, Upnor Side.—"S" to "E."—Three composite piers, ramp raft (*Fig.* 8), 30 108-gallon casks; length, 30 feet.

"E" to "F."—Five composite piers, ramp raft, 50 108-gallon casks, supporting four Service pontoon trestles; length, 75 feet.

"F" to "B."—Nine Service pontoon trestles, length 135 feet, transoms raised and lowered by chains and differential tackles.

4. *Construction.*—The two tidal ramps, "A" to "Z" and "B" to "S," involving the heavier work were constructed between the 27th of May and the 6th of June. The floating portions were made between the 4th and 6th of June. On the 9th of June the two floating portions, "Z" to "Y" and "U" to "S," were made into bridge and warped alongside the Dockyard wall and Upnor Hard respectively. Commencing at 5.30 a.m. on the 10th of June, these portions were warped out on the stream side as far as "Z" and "S," and then swung into position. The cut rafts cast their own anchors and manœuvred into position.

The bridge was then broken up into rafts.

5. *Personnel.*—For instructional purposes, 25 officers, 31 N.C.O.'s, and 245 men were employed in making and working the bridge. These numbers could be reduced to 4 officers, 29 N.C.O.'s, and 220 men. The proper complement of a 2-boat raft is 1 commander and 7 men. Six N.C.O.'s and 36 men are required in addition for manning boats.

6. *Stores used.*—

Pontoons	55
Casks, 108-gallon	164
Service pontoon trestles	13
Composite trestles	6
Four-legged trestles	3

7. *Buoyancy.*—The following gives the buoyancy and strength of the various points of support in the bridge :—

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	Weight bridge will carry per bay of 15 feet (in lbs.).
Pontoons.—When immersed within 15 inches of gunwale	4632
12 „ „	6050
9 „ „	7658
6 „ „	9088

Barrel Piers of seven 108-gallon casks, 6,804 lbs. per bay of 10 feet.

Barrel Piers of ten 108-gallon casks, 9,720 lbs. per bay of 15 feet.

Strength of Pontoon Trestle.—Has been tested up to 12 tons.

Strength of Transom Composite Trestles.—10-inch fir spars per bay of 15 feet.

Total weight of material used in the bridge = 117½ *tons.*

The following is the detail of *personnel* :—

Position on Bridge.	Officers.	N.C.O.'s.	Men.	
Tidal Ramp "A" to "Z" ...	Capt. Sankey, R.E., A.I.F. 1 Subaltern, R.E. ...	2	12	117 Party, R.E.
Cut at "Z"	O.C. E Co., R.E. ...	—	4	
Nos. I. and II. Rafts, including Sliding Baulks.	1 Subaltern, R.E. ...	2	14	
Nos. III. to VII. Rafts ...	2 Subalterns, R.E. ...	5	35	
Nos. VIII. to XI. Rafts ...	O.C. 7th Co., R.E. ...	4	28	7th (Field) Co., R.E.
Cut at "Y"	1 Subaltern, R.E. ...	—	4	
4-Boat Cut Raft "Y" to "X"	1 Officer, 7th Co., R.E.	1	8	
Cut at "X"	.....	—	4	
3-Boat Cut Raft "X" to "W"	1 Officer, 7th Co., R.E.	1	8	
Cut at "W"	.....	—	4	
3-Boat Cut Raft "W" to "V"	1 Officer, 9th Co., R.E.	1	8	9th (Field) Co., R.E.
Cut at "V"	.....	—	4	
4-Boat Cut Raft "V" to "U"	1 Officer, 9th Co., R.E.	1	8	
Cut at "U" and	O.C. 9th Co., R.E. ...	4	28	
Nos. XII., XIII., XIV., and XV. Rafts	1 Subaltern, R.E. ...			
Nos. XV. and XVI. Rafts and Sliding Baulks.	1 Subaltern, R.E. ...	2	14	119 Party, R.E.
Cut at "T"	1 Subaltern, R.E. ...	—	4	
6 Barrel-Pier Rafts "T" to "S"	2 Subalterns, R.E. ...	6	42	118 Party, R.E.
Cut at "S"	O.C. F Co., R.E. ...	—	4	
Tidal Ramp "S" to "B" ...	Lieut. Du Boulay, R.E., A.I.F. 2 Subalterns, R.E. ...	2	12	
3 Cutters	3 Subalterns, R.E. ...	3	24	119 Party, R.E.
3 Wherries	.....	3	12	

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In connection with the reports in the newspapers of the construction and working of the above bridge, Lieut. G. F. Brown, C.B., R.E., sends an amusing extract of orders issued in 1779 by Lieut. C. Shipley, Corps of Engineers, as showing how the authorities in those days avoided making a "cut" in a pontoon bridge. The bridge in question was one devised by Colonel Debbieg, Chief Engineer, and thrown across the Thames, near Gravesend, for the purpose of transferring an army from Kent to Essex and *vice versâ*, at a time when there was great fear of invasion. The extract reads as follows:—

GRAVESEND, *August 25th*, 1779.

INSTRUCTIONS for Mr. Green relative to the stopping of Shipping etc. whilst the Barges are Manoeuvring this day.

You will take care to be well above or below the Communications according to the different Times of Tide, if the Barges work on the Ebb tide, you will cruise off Mr. Webbers, or in the Northfleet Hope. If on the Flood in the Hope.

You will speak to all Vessels, and require them immediately to come to an Anchor, acquainting them with the Hawsers being stretched across the River.

You will have a Serjeant and Twenty Men with their Arms and Ammunition in the Sailing Boat with you, who will have Orders to follow your directions. Therefore should Vessels persist in making their way after you have hailed them, you must immediately order half of the people to Fire with Ball amongst the Rigging etc. Should they not immediately attend to that, the Rear Rank will also Fire amongst their Sails and Rigging. Should not this still have the desired Effect, You will directly man the Eight Oard Boat, and take in as many of the Party as it will hold, go on Board and cut the Anchor from the Bow and let it go with all her Sails Standing.

The Sloop will at the same time run up as close as possible and the remainder of the Party remain on the Deck, ready to give you every assistance in their Power. You may further acquaint the Masters and Pilots, that should they by their rashness be the Means of the Hawsers being cut, and thereby obstruct His Majestys Service, they may lay it to the Account of their own Obstinacy.

CHARLES SHIPLEY.

MR. JOSEPH GREEN, *Cockswain of the Chief Engineer's Boat.*

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SOME NOTES ON THE OPERATIONS OF LEE AND GRANT IN NORTHERN VIRGINIA IN MAY AND JUNE, 1864.

By LIEUT.-COLONEL J. E. EDMONDS, R.E.

THESE notes on the campaign in Northern Virginia in May and June, 1864, which is one of the subjects set for the promotion examination in November next, were originally compiled for the assistance of a friend; it has been thought that they might be of service to other officers who are preparing to submit themselves to the examiners. They may also prove of general interest, as strategically the operations which are included in the above period turn on the successful defence of a capital, by a numerically inferior covering force, against an army led by a general who was "determined to hammer continually against the armed force of the enemy and his resources, until by mere attrition, if in no other way, there should be nothing left to him but submission"; * while tactically they deal with the attack and defence of entrenched positions improvised on the field of battle.

The effective range of aimed rifle fire in 1864 was, it is true, only 300 yards, but as the campaign was fought mainly in country so thickly wooded and overgrown with trees and scrub that the enemy could rarely be seen even at this short distance, there are, in spite of the improvement in firearms, tactical lessons to be learnt from the battles as regards fighting in enclosed country, while as examples of the general nature of the attack and defence of entrenched positions they have lost little of their value.

The Situation.—At the opening of the campaign the Army of Northern Virginia, under General Robert E. Lee, some 60,000 strong, including 8,000 cavalry and 220 guns, held a fortified position about 20 miles long on the southern bank of the Rapidan River (say, on the Ouse, north of Cambridge†), 60 miles north of Richmond (London),

* The up-to-date equivalent of this sentiment is to be found in the German *Infantry Training*: "Forward on the enemy, cost what it may."

† The attempted parallel between Northern Virginia and the south-east corner of England does not include the configuration of the ground; but if the south-east corner of England is imagined to be without the chalk formation and otherwise what it probably was like 800 years ago—covered with woods, close thickets, and marshes, with very few clearings and open spaces, except in the southern section, where there was much

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the Confederal Capital, and facing north; two army corps, those of Lieut.-Generals Ewell and A. P. Hill, occupied the position with their foremost troops, the remainder being in winter quarters in rear, while the army corps of Lieut.-General Longstreet was held in reserve. The cavalry, under Lieut.-General J. E. B. Stuart, was concentrated lower down stream.

For the purposes of the campaign the Rapidan River may be regarded as a sea, of which the South had lost command, for Lee's cavalry was unable to cross it and ascertain what was going on beyond it. The Federals had actually complete command of the sea.

The main Federal force in this theatre at the disposal of Lieut.-General U. S. Grant, who had been recently brought from the west, after his success at Chattanooga, to command all the armies of the United States, consisted of the Army of the Potomac, under Major-General Meade, recently reorganized into three army corps under Major-Generals Hancock, Warren, and Sedgwick, and a cavalry corps, under Major-General Sheridan, together with the army corps of Major-General Burnside (a former and unsuccessful commander of the Army of the Potomac, senior to Major-General Meade), under the direct orders of General Grant. The strength of this force was about 120,000 men, including 13,000 cavalry, and 300 guns. It was in the neighbourhood of Culpeper (say, Peterborough), about 10 miles north of the Confederate position, with its outposts on the Rapidan (Ouse) River.

Besides the main force, the Army of the James, under Major-General Butler, consisting of two army corps (Major-Generals Gillmore and W. F. Smith) and a cavalry division (Brig.-General Kautz)—about 40,000 men, of which 5,000 were cavalry, and 90 guns—was concentrating at the mouth of the James (Thames) River, about 80 miles south-east of Richmond (say, near Margate). In and around Washington (Boston, in Lincolnshire), 100 miles north of Richmond, were 40,000 to 50,000 men, retained for the defence of the Capital. In the Shenandoah (Severn) Valley was Major-General Sigel with 6,500 men, with a part of his force, of the same strength, detached under Major-General Crook in the Kanawha Valley (Central Wales).

Confronting the detachments west and south-east of the capital, General Lee had about 6,000 men defending Richmond and Petersburg, which were reinforced, after Butler had commenced moving, by

Indian corn grown; the bottom lands near the rivers, and especially the sources of the smaller streams, marshy; no roads, only a few tracks—a very fair idea will be had of the theatre of war. The woods were in some places of pine, through which it was difficult for a horseman to force his way, but generally oak predominated; in places the large trees had been cut down, and a jungle of young growth had sprung up, which was more impenetrable than the pine.

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19,000 men collected from South Virginia and North Caroline by General Beauregard. In the Shenandoah there were about 5,000 men under Major-General Breckenridge.

While Lee was confronting Grant in the eastern theatre of war during the two months in question, in the western, 450 miles south-west of Richmond, Lieut.-General Joseph E. Johnston, with 60,000 men, was opposing the advance of a numerically superior Federal force (about 109,000 men) under Major-General Sherman. The operations in the two theatres of war at this period were separate, and beyond the fact that Grant and Sherman commenced moving simultaneously at the same hour, had only a general relationship to each other. No attempt was made by the Confederates to utilize interior lines, and to withdraw forces from one theatre to assist in obtaining a victory in the other. The number of men who could have been spared, owing to the large Northern forces in both theatres, was too small to be of decisive effect; nor does it seem likely that the South had sufficient rolling stock available to move a large number of men rapidly; it had taken the Federals, with their enormously greater resources, 11½ days to move 23,000 men from Virginia to Tennessee after the defeat at Chattanooga. The operations of Sherman had the effect on the campaign in Virginia that they prevented reinforcements being sent from the west to Richmond; while later on, as he pushed forward and gradually deprived the South of territory whence it had drawn men, supplies, and other resources, he contributed possibly more to the final surrender than the force immediately under Grant's eye in the east; for the Army of Northern Virginia stopped going from inanition rather than defeat. But unless Grant had held Lee fast, Sherman's task would have been far more difficult than it was, and perhaps had been impossible. It was definitely agreed between Grant and his subordinate that, should their opponents try to utilize interior lines, and withdraw forces from one theatre, every endeavour should be made to push on after the retiring force at the highest speed possible.

The Two Armies.—In addition to being numerically superior to its foe, the Northern Army was better equipped, supplied, and provided than any Confederate Army that took the field at any period during the war; nothing was lacking to it which money could purchase. The Southerners, on the other hand, had suffered severely during the winter from insufficient clothing and food; they existed largely on mealies and vegetables, receiving a small meat or bacon ration only twice a week, and in the coming campaign numbers were without shoes or headdresses, and there was constant lack of ammunition.

The Confederate Army, however, enjoyed the advantage of sound military organization; the same units had existed from the commencement of the war, had been filled up by drafts, had maintained their traditions, and established *esprit de corps;* the officers had

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remained with it, and the senior ones were nearly all graduates of West Point.

In the Northern Army units were raised and allowed to die out, their places being taken by fresh ones under new officers; this vicious system seems to have been in favour with the various State Governments, for the reason that it gave them frequent opportunities of nominating new batches of persons for the rank of officer, for officers were raised with a unit, and disappeared, as a rule, with it. Conscription, though it had been made legal, was rarely enforced, for the reason that large sums were raised by subscription to pay bounties to secure the necessary number of the State contingent, and so to make the application of the law unnecessary. Substitutes also were allowed. Although there was a large percentage of men who had enlisted from patriotic and conscientious motives, yet they did not form a majority, and in the severe fighting of the campaign they suffered a far heavier percentage of loss than the recruits who had enlisted for the sake of a bounty and hoped to earn another by re-enlisting at the end of the period for which they had engaged. What little *esprit de corps* and tradition did exist in the army corps, divisions, and brigades of the Army of the Potomac had been sorely wounded and broken in March by the arbitrary dissolution of these higher units and the formation of three army corps from the five which had borne with honour the burden of several campaigns, though composed, it is true, of varying regiments. Thus the First and Third Corps disappeared altogether. Finally, many of the generals had received no military training, and had been appointed for political reasons:—Butler, who commanded the Army of the James, was a civilian, who had never shown any proof of military capacity; Sigel, commanding in the Shenandoah Valley, was no better; as Halleck said of him, "He will do nothing but run. Never did anything else." Grant, on taking command, requested the removal of some hundred such generals, but President Lincoln found himself unable to comply with his wishes to any great extent. "Steps of this sort, however, were not to be taken without difficulty, for they intruded on the domain of politics. Nearly every officer of importance who was displaced would become an enemy of the Administration, while his friends would protest against the injustice done him and threaten to oppose the President at the next elections."*

A notable characteristic of both armies was their fondness for, and skill in, entrenching directly they found themselves in the presence of the enemy.

The Campaign.—The main outlines of the campaign are exceedingly simple, and, taking London to represent Richmond, ran roughly as follows:—Lee is on the Cambridgeshire Ouse (Rapidan), with his

* *Badeau II.*, 29. The Presidential election was at the end of 1864.

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left flank at Huntingdon. Grant, on account of his overwhelming superiority in numbers and the general situation, having the power of strategic surprise (equivalent, as before mentioned, to command of the sea), commences moving at midnight on the 3/4th May, and crosses the Ouse just below its junction with the Cam with the intention of turning Lee's flank. Lee at once sets his three corps in motion eastward through Cambridge, and the two armies come into collision, as the various divisions arrive on the field, at Fordham, near Newmarket (the Wilderness). During the 5th to 7th May the Federals lose 17,666, the Confederates between 8,000 and 11,400 men.

Unable to make any impression, Grant determines to continue the movement to his left flank, and on the evening of the 8th May starts his force off towards Cockfield, Essex (Spottsylvania), 15 miles to the south-east.

Its advance is delayed by the Southern cavalry, which enables the Southern infantry to reach Cockfield before the Federals. The two armies fight on a line running roughly north-west and south-east during the 9th to the 19th May, Grant gradually edging his force towards its left by the nocturnal transfer of troops. The Federal losses are about 19,000 men, those of the Confederates considerably less.

Before this battle commences Sheridan's cavalry force is sent off on a raid, and is followed by a portion of the Southern cavalry; he does some easily-repaired damage to railway lines, finds London defended by fortifications, and returns to his army by re-crossing the Thames below London.

On the night of the 20th May Grant again begins moving to his left, towards Halsted (Hanover Junction), on the Colne (North Anna), but Lee again is able to interpose. The armies face each other on the Colne the 24th to 26th May. Grant's right and left wings are south of the river, but his centre is on the north bank; being strongly entrenched, he is not attacked, but he also, seeing that there is little chance of attacking with success, moves, preceded by his cavalry, towards Brentford (Cold Harbour); Lee follows suit. In the attacks made on Lee's hastily-constructed entrenchments over comparatively open ground during the 1st to the 3rd June the Federals lose some 12,000 men, the Confederates about 2,000, when General Meade suspends the fighting by Grant's direction.

Meantime Butler's 40,000 men, who had been assembled at Margate, had been conveyed by water to Chatham, and after making a feeble advance are bottled up by Beauregard in the Hundred of Hoo (Bermuda Hundred), between the Thames and the Medway; part of the Southern force is then withdrawn to assist Lee and part of Butler's force (Smith's Corps) is withdrawn by water to join Grant. Sigel's force in the Severn (Shenandoah) Valley is also defeated, and part of Breckinridge's force then called to Lee's Army.

Grant now determines to carry his flanking operations still further,

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and commences crossing the Thames (James) at Tilbury, completes the passage by the 15th, and moves on Sevenoaks (Petersburg). A partial attack by two corps on the entrenched lines at this place fails, and Grant sits down to conduct siege operations.

While Grant is making his arrangements for crossing the Thames, a force of 11,000 men under Early is sent to Bath to work north-eastwards and threaten the Northern capital, Boston, in Lincolnshire.

During the whole of the above operations Grant's lines of communication, being to the sea on the east coast, are shifted southwards as required, and are always covered by his front.

Grant's Strategy.—When Grant took the field against Lee for the first time the experiences of the previous Federal commanders in the Virginian theatre of war were available for his guidance. The endeavours of Generals Pope, Burnside, and Hooker to manœuvre against Lee had led to disastrous failure, while remaining inactive and inviting attack as practised by McClellan and the two last-named generals had given Lee opportunities equally calamitous to the Federal cause. The lesson might perhaps have been deduced that Lee was naturally more inclined to undertake bold operations when at a distance from Richmond than when danger to the capital compelled him to remain near it. The lesson should have been deduced that a very large numerical superiority was required to inflict a defeat on the Army of North Virginia.

The essence of Grant's plan of campaign was to stick close to Lee's Army; he wrote to General Meade: "Lee's Army will be your objective point. Wherever Lee goes, there you will go also"; and to this plan he adhered with the utmost persistency. In all previous campaigns of the war there had been pauses between the battles during which both sides refitted and recruited; now from the 5th May, 1864, when the fighting in the Wilderness commenced, until the 9th April, 1865, when Lee surrendered at Appomattox Court House, the armies were in close contact, and scarcely a day passed without fighting.

This was Grant's so-called policy of "attrition." His initial attempts to expedite it by hurling superior numbers against the Southern forces regardless of losses, content if a not disproportionate number of his foes were placed *hors de combat*, must be accounted a tactical failure. He could certainly replace his losses, while it became increasingly difficult for the South to find men, but no troops could be expected to carry out such a process day after day; and Cold Harbour showed that neither commanders nor men would continue it.* No troops, except perhaps fanatics, will stand con-

* When the order to renew the attack was given, Hancock used his discretion and declined to move forward; Smith refused to obey. In the 6th Army Corps the order to advance was given to the men, but they merely re-opened fire without advancing.

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tinuous heavy losses. The ordinary soldier expects to have a reasonable chance of returning home to tell the tale. He will not fight for generals who always have a heavy butcher's bill and no visible success in the form of captured trophies and prisoners or conquered territory. Grant's change of methods after he had crossed the James River is indication that he recognized that his men would not respond to his original programme.

That the campaign was strategically a failure is proved by the facts that at the close of the period under consideration Lee was able to detach 11,000 men, under Lieut.-General Early, to threaten Washington, and the Confederate lines of supply were still intact.

Given Grant's three to one superiority in numbers, he was justified in making detachments, but it can hardly be said he made them as small as possible.* The leaving of the original detachment in the Shenandoah Valley was unavoidable :—There was a Confederate force there, and the valley had been and was again to be the path for threatening Washington. Grant's directions to Sigel to defeat Breckinridge, to combine the detachments in Western Virginia with his own, and advance *viâ* Lynchburg and Gordonsville towards Richmond (in which neighbourhood Grant hoped to be) were in accordance with sound strategy ; they might have been bettered if the advance had been ordered direct *viâ* Gordonsville, without the delay of a detour to Lynchburg. The detachment failed because of the incompetency of its commander, as Butler's detachment also failed. The best and most skilled officers must be selected for the command of independent detached forces ; but, as already pointed out, Grant was unable to get rid of all "political generals" at once ; later he certainly rendered great service by insisting on the employment of none but the right men.

Butler's detachment of nearly 40,000 was a very large one (Grant eventually withdrew Smith's corps from it, which may perhaps be taken as recognition that it was too large, or at any rate that men were more wanted elsewhere). Grant's hope that the mere threat of its presence south of Richmond would induce Lee to make heavy detachments to defeat it, or cause him to retire nearer to Richmond, was a miscalculation which showed he did not appreciate Lee. A force of this size ran a great risk of being cut up before Grant could help it, if Lee attacked it seriously. If the Army of the James was merely to be a threat, then 10,000 men would have answered the purpose equally as well and could have been more easily withdrawn. Grant's orders to the detached force were by no means explicit, and

* There were 662,345 Union soldiers present for duty on the 1st May. Of these Grant had in the field in the east about 173,000, Sherman in the west 109,000 ; the rest were doing garrison duty and were practically of no account except as police. The remarks here apply to the 173,000 men immediately included in Grant's campaign.

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the movements expected of it were dependent on the success of his main force, which never developed. It would appear that he expected Butler to invest Richmond from the south while he himself co-operated from the north; that he collected a large siege train would seem to indicate that he anticipated an investment and bombardment in the first campaign. The capture of Petersburg, which would have been easy if attempted by a rapid movement directly the campaign opened, and undoubtedly a decisive step towards the end, was not alluded to in Grant's directions. A commander like Butler, however, who when detached requires detailed orders to compel him to render intelligent co-operation, is of doubtful assistance to a commander-in-chief, and it is better to utilize his services where they can be closely controlled from Headquarters.

If the whole of Butler's force had been brought north of the James River (as one corps of it was later), had been utilized to seize Cold Harbour and Hanover Court House in advance of Grant, and thus to threaten Lee's right flank, it might have produced decisive results, and yet would have been so near to Grant that it could not have been attacked without his being able to succour it. The separation of the forces was unnecessary, and after the Battle of the Wilderness Grant seems to have had misgivings about it, for he sent urgent messages to General Halleck for "all the infantry you can rake and scrape." Generally the division of force in a small theatre of war like Northern Virginia is a mistake, unless for the special purpose of ultimate combination on the battlefield. Both Butler and Sigel were too far off for concerted action with Grant, and liable to defeat, as happened, without Grant being able to render them assistance. It is true they occupied part of the Southern forces, but by no means an equivalent number of them. It was, however, the last exhibition of isolated effort, want of co-operation, and division of forces on the part of a Northern commander; and it may even be said of Grant's initial movements that they were sufficiently energetic, simultaneous, and well directed to hold the enemy fast and to deprive him of the power of reinforcing the most threatened point to any great extent from elsewhere.

Having decided to take the initiative, Grant had the choice of attacking Lee's position on the Rapidan River or crossing above or below it, so as to turn the left or right flank of his opponent. The first alternative does not seem to have been considered at all by Grant; there was, it is true, an unfordable river in front of the position, and any attempt to force a passage would have been equivalent to making an opposed landing on a beach; but Grant had an enormous superiority in heavy artillery, which might have been made use of to bombard the position and hold the defenders to it. As there would have been an obstacle between the guns and the enemy, a small escort would have sufficed. No diversion seems to have been

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made to distract attention from the crossing that was made elsewhere. Strategically there were very good reasons for selecting the line of advance by the east; the seacoast, with the very numerous waterways leading inland from it, was always behind Grant, giving him instead of an ever-lengthening line of communication a series of short and secure ones (as the Japanese had in Korea). By the western line he would have had to rely on one single-track railway, little better than a contractor's line, and he must have made detachments to guard it, as its direction was diagonally across the enemy's front. It is said that Grant feared that if he moved west Lee might have advanced towards Washington, but it is doubtful whether he would have abandoned Richmond at this stage, and it is difficult to conceive how he could have kept his troops supplied, except from Federal magazines, as the whole country from the Rapidan to Washington was by this time absolutely bare. There would have been risks by the western line; but it must be remembered that later on, when Grant was south of Richmond, all his endeavours were directed to cutting Lee off from the west, and it was by using Sheridan's cavalry to head Lee off from the west more than a year later that the final surrender was brought about.

Tactically the advance by the eastern flank offered serious disadvantages; the country there was difficult, and therefore in favour of the better-trained troops; it offered no facilities for the employment of artillery and was practically unmapped.

It has been suggested that Grant might have advanced as McClellan did, in 1862, by the Yorktown Peninsula, or that he might have made the Army of the James stronger than the Army of the Potomac. Against the former proposal it is urged that the large amount of time and the large number of vessels required to transport the men would have given Lee warning, and that this movement would have uncovered Washington. Lee could certainly have delayed an advance on this line, for no outflanking movements by Grant would have been possible with a broad river on each side. It does seem, at first sight, that as Grant chose eventually to transfer his whole force to the south of the James River, he might have saved much loss of life and of time had he gone there originally. As he was prepared to make large detachments, he might have given Meade the smaller force to hold Lee, and himself going to Butler have made the principal attack with the Army of the James. Grant's objective, however, was Lee's Army, and such a use of his troops might only have led to the capture of the city of Richmond, and this at the expense of the defeat of the force under Meade, when Lee would have been free to devote his whole attention to the Army of the James.

Generally, Grant's strategy must be considered as eminently safe and suited to the political exigencies.

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The detachment of Hancock's Corps after the Battle of the Wilderness, as a lure to Lee, failed, as might have been expected of so ancient a ruse of war. The risk again was not worth the result expected. The corps, if Grant was prepared to hazard it, would have been more usefully employed (in combination with Sheridan's cavalry) in seizing some advanced point, *e.g.*, Spottsylvania cross roads, of strategic value, or in acting against a flank while the frontal attack was in progress.

Grant, on the other hand, allowed his whole force to be diverted from his march and attracted by Ewell's Corps (in the Wilderness) instead of using the advantage of the initiative to press on to ground more favourable to his numbers and artillery.*

Grant's passage of the Rapidan was a striking success, and that success should have been pushed. His battle in the Wilderness and his processional flank march from the Wilderness to Spottsylvania, and from Spottsylvania to Cold Harbour in contact with Lee, and his continuation of the movement across the James, were of no avail, as Lee had always a shorter distance to march on interior lines to confront him again, and his movements were made so slowly that Lee had time to entrench. If he could have held Lee with part of his force while the remainder (or Butler) enveloped Lee's right flank, the Southern case would have been difficult. As pointed out under night operations, the manœuvring by night, by which Grant sought to gain advantage, wore out his troops and made them less fit to meet the foe when eventually they reached their allotted positions. That the fighting of the Northerners after they crossed the James River was never up to the standard of that done in the Wilderness is probably due to deterioration in quality of the men ; the best and bravest had fallen in the wholesale slaughter of the earlier battles.

Lee's Strategy.—Lee's strategy must also be characterized as safe ; the situation was too serious for him to endeavour to compensate for lack of adequate numbers by the brilliancy and novelty of his movements. The capital of the Confederacy, which was also its greatest arsenal and storehouse, was threatened. Had it been completely defended all round by forts and fortifications so as to make it safe from an assault, except at an enormous expenditure of life (as von Moltke considered Paris was in 1870), he might have felt himself more free to manœuvre. Basing himself on Lynchburg (the third largest city in Virginia), he could have operated against Grant's flank whenever he tried to extend his line westwards.

Lee's three corps in winter quarters in the neighbourhood of

* The defenders in the Wilderness also had the great advantage that they could lie unseen, while the attackers had to advance, practically as game driven to the hunters, disclosing their presence as they forced their way through the brushwood. Not to get through such unsuitable ground as fast as possible was a most unfortunate mistake.

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Orange Court House and Gordonsville were practically in a flank position covering Richmond. On account of his superiority in numbers the initiative lay with Grant, and with it the advantage of strategic surprise. Lee had to be prepared to meet any move that he should make.

Roughly, the three Confederate corps were arranged in a triangle with the base towards the north; this may have been for the convenience of cantonments and supply. It is easy to see that had the apex been towards the north (say one corps occupying the position on the Rapidan with advanced troops, supported by the remainder of the corps, with the two other corps in second line) then one and a-half corps would have been immediately available to meet any attempt to turn either of his flanks.*

It is said that Lee had early intelligence of Grant's decision to push south-eastwards; if so, the position of his corps might possibly have been improved, for at midnight, when Grant commenced to move, they were distant from his probable route through the Wilderness: Early's Corps, 18 miles; Hill's, 28; and Longstreet's, 38 (by road 42). If two or all of Longstreet's divisions (actually at Mechanicsburg, south of Gordonsville) had been nearer to Hill they might have intervened on the 5th instead of the 6th, and the Wilderness might have been a Southern victory.

Lee's detachments—that of Breckinridge, in the Shenandoah Valley, and that of Beauregard, near Petersburg—appear to have been calculated with great nicety; they were just strong enough to defeat the more numerous forces, under indifferent generals, which were opposed to them. Directly they had successes Lee withdrew 2,500 men from the Valley (on the 15th May) and Pickett's Division (on the 16th, and later Hoke's) from Beauregard.

Lee was too inferior in numbers to force the fighting; as von Clausewitz puts it: "He who has to seek a result by delaying the enemy, and must economize the lives of his men, should not of his own accord increase the intensity with which the war is waged." His chance lay in the enemy's mistakes: "The weaker one is, the more one must live by the faults of others."

It has been suggested that had Lee not been ill after Spottsylvania more advantage might possibly have been taken of the division of the Federal forces when they lay on the North Anna; but they were entrenched and their flanks secure, and therefore they were in little danger from Lee's inferior numbers. The situation in no way resembled that of McClellan on the Chickahominy in 1862.

Early's raid to Washington, like Lee's series of defensive positions, was only a means of gaining time and of taking the pressure off

* The formation above suggested is really a square with half a corps at each of the upper corners and a whole corps at each of the lower ones. Such a formation is now much in favour with French strategists.

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Richmond; no decisive results could be expected of 11,000 men utilized in this manner.

A somewhat interesting comparison might be drawn between Lee's strategy at this period and Frederick the Great's in the later part of the Seven Years' War. Lee's flank position might be compared to Frederick's at Schmottseifen; but Frederick, after his defeat at Kunersdorf and the disaster at Maxen, did not (as Lee after Gettysburg) abandon the offensive, as is evidenced by the Battles of Liegnitz and Torgau. It must, however, be borne in mind that Frederick was not opposed by a Grant, and that the standard of discipline of the Prussian troops did not fall off as that of the Southerners. In the Prussian Army there was always hope; in the Confederate each action was only one step nearer the end, a proof, perhaps, of the true measure of the defensive.

Moving on shorter lines Lee was always sure of being able to interpose between Richmond and the enemy, and to hold him in the difficult country, but he could do no more.

Lee's Tactics.—Throughout the campaign the force at the disposal of Lee was too weak to take full advantage of the opportunities offered him by Grant; a defensive position has fulfilled its purpose when it has delayed the enemy, or caused him heavy loss through a too contemptuous attack on it; a general who clings to a position or a series of positions cannot expect to achieve a victory that will have a real effect on the course of the war. Had Lee been able to form an offensive wing as well as a defensive one, and to attack Grant while he was assaulting the entrenchments or immediately after he had failed, such a victory might have been his. Von Werder's excellent defence of the Lisaine position in January, 1871, for instance, merely stopped the French; it was von Manteuffel's force coming down on their flank which drove them out of the theatre of war. Wellington's army at Waterloo may also be regarded as a defensive wing; it held the French, but without the action of Prince Blücher's offensive wing it could not have brought about decisive results. Had Kuropatkin at Liao-yang used his left wing to attack the Japanese south of the Tai-tzu River while two and a-half of their three armies were detained in front of the Shou-shan-pu position, instead of letting it wait to be attacked, as it eventually was by a far inferior force, the course of the Manchurian War might possibly have been changed. But for reasons very different to those of Lee the Russian commander clung to positions; even his attempts at the strategic offensive at Te-li-ssu and the Sha Ho merely ended in the tactical defensive. That Lee was perfectly aware of the course which offered the best results is proved by his use of Jackson's force at Chancellorsville as an offensive wing while he held the Federals on part of their front with his main force.

The value of a defensive position held by a small force was

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exhibited at the Ya-lu; the Japanese spent many days in preparing to attack it, and had General Zasulich evacuated it directly the Japanese showed signs of advancing, it would fully have answered its purpose. The Nan Shan position did good service, but was also held a little too long. The action at Ta-shih-chiao showed signs of better generalship; the defensive position there detained the Japanese and caused them heavy casualties, and was evacuated without loss during the night.

Lee of course had not elbow room for this manœuvre; the foe was so close to Richmond that he was bound to cover it directly and dared not retire. General J. E. Johnston, who was opposed to Sherman, had the necessary space, and utilized it by taking up successive positions.

Under the conditions imposed on him, Lee chose a nearly pure defensive attitude; the few attacks he judged it opportune to make, as for instance that on the 2nd and 6th Federal Corps on the 22nd June, led only to temporary successes; his opponents were able to re-occupy almost immediately the ground they had lost.

Lee, for the same reasons, perhaps, which prevented his taking the strategic offensive, attempted no great counterstrokes. On the morning of the 2nd June at Cold Harbour he sent Rode's division of Early's Corps to attack the Federal right flank, and it was able to roll it up for a considerable distance and even to take it in rear. Most of his counterstrokes, however, were purely local and carried out to the front; they led to heavy losses and small results, as might be expected, for the troops engaged in them had naturally to cease firing to a great extent during the movement, to abandon their cover, and to cross the very obstacles which had been embarrassing their opponents; they were never followed by a line of fresh troops to secure the advantage gained.

The defensive lines of the Confederates were never selected by Lee, although he endeavoured sometimes to rectify them; they were merely the best lines available taken up by the troops themselves; working parties of negroes were brought up to strengthen their profile; in many cases, however, the parapet consisted of nothing more than a log, behind which the firing line lay. In the plans of the battles the lines appear very irregular and haphazard, but the cause of their apparent want of system was the desire of each unit to get to a place where a clearing or high ground would enable it to secure a good field of fire. The extraordinary protuberance to the line at Spottsylvania, known as the "Bloody Angle" or the "Mule Shoe," an inverted U projecting nearly a mile in front of the general line and open to attack on three sides, was occupied because it commanded a good view.

Grant's Tactics.—Grant's methods of attack must be considered faulty; he attempted to take the Confederate entrenchments by

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main force, and failing to do so manœuvred to place his army so as to turn the positions, only to find his enemy confronting him again. It would appear that a turning movement is of little use unless the enemy is held in front at the same time by the attack of a sufficient body of troops; the frontal attack of the Second and Fourth Japanese Armies at Mukden while the Third Army endeavoured to turn the line is an instance on a large scale of the necessary procedure, but no more classic example can be found than the operations which were being carried on at this very time by General Sherman to dislodge General Joseph E. Johnston; true he only advanced 100 miles in 100 days, but he did advance and did reach Atlanta.

If the force is too weak to make a determined frontal attack and a turning movement at the same time, and the position is a strong one, a turning attack, if the ground permits of it, may be made in the hope of finding the new position assumed by the enemy less strong than the original one; otherwise recourse must be had to siege works and approaches, or at least an accelerated form of siege warfare. Grant resorted to this procedure after Cold Harbour, but he evidently thought it too slow, for he made one more attempt at assault in his first attack on Petersburg.

The procedure for the attack of a position that cannot be turned, which is advocated on the Continent, is that a series of entrenched infantry positions should be taken up during successive nights, until an "assault position" is reached, that is, one so near to the enemy that an assault in the dark offers reasonable chances of success; from this position parties are sent out to reconnoitre and destroy the obstacles, to select routes, etc. While the infantry and engineers are thus engaged the artillery from concealed positions or epaulments engage the enemy's guns and keep their fire down until the moment of assault.

Against an enemy who is preparing a position instant attack by the shortest line before he has had time to make it formidable is probably the surest and easiest road to success.

Entrenching on the Battlefield.—The failure of the Federals with superior numbers to capture the Southern entrenchments was perhaps due to the nature of their troops; it must not be forgotten, however, that the assaults of the Confederates at Gettysburg had also failed.* Both sides in this stage of the war were too much given to entrenching themselves directly they had deployed for action, a habit which Stonewall Jackson's men were never permitted to learn,

* It may be noted that the Northerners were not anxious to cross bayonets with the Confederates. At Spottsylvania Robinson's brigade was persuaded to charge home up to a breastwork by being given the false intelligence that it was only held by cavalry (who were known to have no bayonets). In this connexion it is of interest to hear that the German cavalry is about to be supplied with a bayonet.

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as his battles from Kernstown to Chancellorsville show. The custom was so engrained that Hancock's Corps on the first day in the Wilderness halted, entrenched, and even made abattis when everything depended on a rapid and resistless advance, regardless of losses, before the Southern right wing grew sufficiently strong to offer any real resistance.* A genuine attack is not to be expected of troops that adopt this principle, and the lifeless course that the attack so often took in the Civil War is a warning that the spade in the attack may have undesired effects. It has of course its true use when an attack is brought to a standstill by overwhelming fire, and the infantry must be given every assistance in maintaining its position, or when it enables a weak force to hold on to the enemy while the decisive attack is made elsewhere, as the Japanese used it in Manchuria, but the attack in the true sense of the word has nothing in common with the use of the spade.

Artillery Co-operation.—Another cause of the Northern ill-success in assaulting entrenched positions was the failure of the artillery to co-operate; this was of course mainly due to the nature of the battlefields, a tangled wilderness of trees and undergrowth, and marsh, with few clearings. This condition, however, must have been foreseen by Grant when he made his choice of the eastern flank for attack. Without proper artillery preparation it is evident that even in 1864 an attack on an entrenched position had little chance of success. Grant had heavy artillery with him, and no doubt would have used it if it had been possible, as at Spottsylvania he actually did bring up and use some small (Coehorn) mortars. Indirect laying of field guns seems to have been unknown in those days.

It was of no use to send in frontal attacks of heavy masses of infantry† without artillery support, as they were stopped by a single line of men with single loaders. Similar attempts by the Russians at Plevna, our own troops at Colenso, and the Japanese at Ta-shih-chiao, Liao-yang, Sha Ho, and Mukden have all failed.

It is worth recalling that a little earlier in the same year, in March, 1864, the Prussians proceeded very differently to the assault of the Danish position at Düppel. The attack was prepared by the fire of 100 siege guns, and although the position was infinitely stronger than the hasty entrenchments of the Confederates, the assault was successful. Perhaps the Prussians paid the position too much honour by spending 19 days before it, but for certain success in the attack of a position there must be a methodic and almost siege-like procedure. The importance of the result in relation to time will

* The respite thus given to Hill enabled him to rectify his line and to entrench, which he had not previously done.

† Hancock's attack at Spottsylvania was made 20 deep; the 6th and 8th Corps attack at Cold Harbour 8 and 6 deep respectively; no attack seems to have been less than 4 deep.

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be the ruling factor in the actual course followed; in the case of Plevna, Todleben, when he took charge, decided on an investment; Nogi at Port Arthur, as his army was wanted for service elsewhere, tried to hasten proceedings by assaults at heavy cost of life.* When a whole frontier like that of France is a fortified position, it must be assaulted somewhere, but in field warfare, if there is room to manœuvre, the procedure adopted by the Japanese at Mukden, as before referred to, would seem the best course:—To establish equilibrium by entrenching opposite the position, so that the front can be held by a (comparatively) small number of men, and then to manœuvre round one or both of the flanks (if sufficient numbers are available). Grant was preparing to do this after Spottsylvania (the trenches were to have been held by Warren's Corps), when Lee moved to anticipate him; should assault, however, be absolutely necessary, careful reconnaissance and the commencement of bombardment to find the weak places must be resorted to. It must always be remembered, however, that the longer a field position remains unattacked the stronger it will become, as opportunity is given to the enemy to improve it.

Night Manœuvring.—Night marches and manœuvring by night in the hope of effecting a surprise at daybreak or of anticipating the enemy at some point were a special feature of Grant's operations. He started at midnight on his first campaign against Lee and commenced his moves to all his new positions by night. As a matter of fact, as surprises, his night marches were failures; Spottsylvania and Cold Harbour show that a night march is a poor means of getting out of a difficult situation. It was also repeatedly proved that even when the night march had succeeded, it was difficult to get the troops into attacking formation unobserved, and the advantage gained was quickly lost. The records show that the troops were reported too tired to attack without rest and without a pause for food, and that those who went into action after a night march suffered more than usual from shock when they were wounded. The case is different when, as so often happened in Manchuria, troops already in position are led forward *short* distances in the darkness, or use the cover of darkness to advance a short distance to a fresh position.

The night time was also much used to shift troops which were in close contact with the enemy. This the Russians also did frequently in Manchuria.

In the attack of the First Japanese Army on the Russian works at Mukden the infantry attacks (or advances) were made entirely by night. The infantry got forward as far as they could and

* Wellington's procedure at Ciudad Rodrigo and Badojoz in 1812 is of interest in this connexion. Time was of importance; he assaulted one after 12 days, the other after 20 days' siege and bombardment.

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entrenched, built up sandbags, or got cover from the ground; during the day they lay unable to move or even raise their heads, but the Russians were prevented from attacking and driving them back by continuous artillery fire. This perhaps is the proper use of the night and a good procedure in the attack of an entrenched position.

In this connexion the translation which appeared in the *Journal of the Royal United Service Institution* of last year, of the views on the attack of positions of the chiefs of staff of the divisions of the Second Japanese Army, written after Liao-yang, will be found of interest.

Reconnaissance.—Both sides appear to have failed to reconnoitre adequately the enemy's movements and positions. There was no proper staff system and the reconnaissance work seems to have been left to the sharpshooters who covered the advance on the position. As a result of this want of system both armies stumbled on each other; there were fierce encounters where they came in contact, and other troops in the vicinity converged towards the fighting, without searching for weak points or for the flanks, so as to produce a decisive result.* In such circumstances a properly combined attack was out of the question and, as in practically all the battles of the Civil War, attacks were not made simultaneously along the whole front.

The uncertainty of the whereabouts of the enemy led, as at Spottsylvania, to tentative measures on the Federal side; the attack was made first with the right wing, then with the centre, then with the left, then with the right again. The experiences thus gained were not, however, altogether lost on the Army of the Potomac, for at Cold Harbour a definite attempt was made to apply all available forces at the decisive point, although from the nature of the ground only three out of the five corps could be brought into action; but in the attacks on Petersburg in June, 1864, the troops were again sent in piecemeal; possibly this was due as on other occasions to the bad work of the insufficiently trained staff officers.

In spite of the increased difficulties of reconnaissance, it is more important than ever to-day to have reliable information before an attack is delivered. It will take a considerable time, and specially trained officers and men must be employed. The Japanese procedure at the Ya-lu, though it seems slow, is no doubt the right one.

Cavalry.—At this period of the war, three years after its commencement, by dint of training and war experience the Northern cavalry, recruited mainly from a population which, if it owned horses at all, preferred driving to riding, was nearly equal in quality to that raised from the sportsmen and hunting men of the South; it was in this

* It is recorded as altogether exceptional that Colonel Upton, who was commanding a brigade in Sedgwick's Corps, examined the ground over which he was to attack at Spottsylvania himself, and made his 12 regimental commanders do the same, and explained to each what his task was.

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campaign half as numerous again as the Confederate cavalry (about 12,000 to 8,000). It had not, however, produced a capable leader, and Sheridan, who was selected by Grant to command it, was an infantryman by training and had never served with cavalry ;* he had commanded all infantry units up to a division ; he was chosen solely on account of his energy and dash.

The cavalry on both sides was in reality mounted infantry ; shock action was not sought after ; there was hardly a sword in either command (if a regiment did possess one it was used for cutting up sheep) ; when mounted parties met they used their revolvers ; both carried rifles or carbines.† Some of the Northern cavalry had the advantage of the Spencer repeating carbine ; they had no bayonets nor lances.

Grant (or Sheridan for him) does not seem at this time to have known how to use his numerous cavalry force. During the advance to and at the Battle of the Wilderness it was not used independently, but as advanced guard cavalry, which merely skirmished with the enemy's horsemen, and as guard of the baggage trains. During the advance to Spottsylvania, General Warren complained that his corps was blocked and retarded by the cavalry. This may possibly be a clue to Grant's extraordinary action in sending his 12,000 cavalrymen off on a raid, when he wanted every single man he could lay hands on to fight Lee at Spottsylvania. During the move to Cold Harbour the cavalry was very properly sent on in advance to secure the high ground ; but, again, when the first attack on Petersburg was made the cavalry was away on a raid. No attempt was made to use this large force to attack Lee's flank or rear, or to impede his advance, or to head him off when he moved, as was eventually done in the closing scene of the war. The raids accomplished nothing—they did not even destroy the Confederate lines of supply ; the small damage done to the railways was repaired in as short a time as it had taken to carry out. It was only discovered later that to make a railway useless the displacement of a few rails is insufficient ; it was eventually found necessary to place whole divisions in single rank along a track, to overturn it by lifting one end of the sleepers by word of command, and then to burn the sleepers and twist the rails.

Far better service was done by the Confederate cavalry. In spite of the presence of a superior force it managed to get in front of Grant's troops whenever they moved, by felling trees to block their progress and by constructing entrenchments to give the appearance of the presence of infantry ; during the fighting it watched the flanks and

* It should, however, be noted that in the four years' course at West Point cadets are taught the duties of all arms.

† In 1870, six years later, the German dragoons and hussars only had carbines ; the firearm of the Uhlans and Cuirassiers at the commencement of the war was a pistol. They eventually carried captured rifles.

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formed a valuable strategic reserve. Its efficiency was largely due to the better knowledge of the country possessed by the men and their good shooting. Few cavalries have rendered their side such valuable assistance. As the ground on which it had to act was quite as unsuited to cavalry work as is the zone of country between London and the coast to the south and east, the factors which contributed to its success against a more numerous body of horsemen are worthy of attention.

Command of the Sea.—Finally attention must be drawn to the fact that although the North had complete command of the sea and the great waterways, this contributed nothing positive to enable Grant to win a victory or to the final defeat of the Confederate States. It gave the Federals valuable facilities in that it permitted Grant, as McClellan before him, to shift his base, and to transfer troops with certainty and ease, and allowed him the advantage of strategic surprise; it presented serious inconveniences to their opponents in that it prevented them from getting assistance from the Trans-Mississippi States, from receiving warlike stores and supplies from Europe, and from obtaining funds by disposing of their produce abroad; but it was not vital to the termination of a life-and-death struggle; in fact, had the attributes of the two parties been reversed, and had the South been the manufacturing community instead of the agricultural one, it would have been of little importance. Nor is this an isolated case of the inherent incapacity of naval supremacy to count as a decisive factor in the termination of a war; Napoleon's sea power was annihilated at Trafalgar in 1805, but it required many years of desperate fighting on land and a final crushing defeat in a land battle 10 years later to end his victorious career.

The absolute command of the sea which the Allies held in the Crimean War did not in any appreciable degree hasten the end or contribute to a definite conclusion. In 1866 the Austrians gained a decisive victory in the only naval battle of the war, but it had so little influence on events that it is practically forgotten. In 1870–1 the French had undisputed command of the sea in the theatre of war. It did not, however, save Paris from capitulation nor the loss of two fair provinces; the best use that could be made of the trained sailors was as artillerymen with the land forces. British naval supremacy aided but little in shortening the long struggle in South Africa with two Republics which possessed no navy whatever. Even Tsu-Shima would not have helped the Japanese in the objects of the war—the re-capture of Port Arthur and undisputed supremacy in Korea—had victory favoured the Russians on land.

In bringing a war to an indisputable finish, command of the sea has no more effect than has the successful defence of positions, and, as General Beauregard said of the Southern passive-defensive policy, "It may make a long agony, but can never win a war."

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STUDIES ON THE USE OF FIELD TELEGRAPHS IN SOUTH AFRICA.

By MAJOR E. G. GODFREY-FAUSSETT, R.E.

WE are constantly being told by those to whose opinion respect is due, that "the South African War was exceptional; it cannot be taken as a precedent; we must train for European warfare." No doubt this is so, but, after all, is it not the unexpected that always happens in war? and in order that this inevitable unexpected may not upset the machine, flexibility of organization is required. Such flexibility can only be produced by a careful analysis of the varying conditions met with on active service.

This is my excuse for asking the hospitality of the *R.E. Journal* for a series of studies on the use of telegraphs in South Africa. I have selected five episodes from many :—

1. A section working in rear of an advancing division (Lord Methuen's advance on Kimberley).
2. A section maintaining the internal communications of a mixed division (Sir John French's operations before Colesberg).
3. A Telegraph Division acting with a force of several divisions across open country (Lord Roberts' march on Bloemfontein).
4. Widely dispersed columns concentrating strategically on an objective (the advance on Pretoria).
5. Semi-permanent telegraphs in guerilla warfare (the blockhouse system in the Transvaal).

It must be borne in mind that the telegraph organization of 1899 was very different to what it is to-day. The Telegraph Division was taken as the unit, and each Telegraph Division consisted of four independent sections. Each section comprised two air-line detachments, and a more or less experimental cable detachment. This organization was intended for advanced line-of-communication work, and though many experiments at manœuvres had given telegraph officers great faith in the use of cable for tactical purposes (a faith shared also by many who had witnessed the trials), it was not, as now, translated into an organization for the purpose.

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I.—LORD METHUEN'S ADVANCE ON KIMBERLEY.

A SECTION WORKING IN REAR OF AN ADVANCING DIVISION.

When the 1st Telegraph Division arrived at Cape Town on the 12th November, 1899, it was met by orders to proceed to De Aar, to there obtain its horses and mules, and to send a section as soon as possible to join Lord Methuen's force, then assembling at Orange River for the relief of Kimberley.

By dint of working all night at unloading the ship, the wagons and stores, with an advanced party to draw the animals, were despatched to De Aar on the afternoon of the 13th, the remainder of the Division following on the 14th.

By the evening of the 16th the animals had been obtained, and the whole Division was assembled at De Aar. The sections were No. 1 (Lieut. Jelf), No. 2 (2nd Lieut. Henrici), No. 3 (Lieut. Moir), and No. 4 (2nd Lieut. Mackworth). All efforts were directed to getting Moir's section into order, telling off the mules and oxen, giving the ponies an idea of discipline, and organizing the native drivers. On the afternoon of the 18th Moir's section left by train for Orange River. His marching-out strength was 1 officer, 2 sergeants, 41 rank and file, 1 conductor, 14 boys, 12 horses, 24 oxen, and 40 mules; with 3 air-line wagons, 1 cable cart, 1 G.S. wagon, and 1 Scotch cart.

Next day the mobility of the section was destroyed at one blow. Moir was informed that water on the line of advance was too scarce for the section to form part of the field force. Nothing remained but to work with the railway companies detailed for the repair of the line, carrying the stores in a truck, and conforming to the movements of the railway breakdown train instead of to those of the Division. The animals and wagons were left at Orange River, and 20 miles of air line were packed in a truck.

As the advance was to be in the Cape Colony, great assistance was rendered by the Cape Telegraphs; wires along the railway were placed at our disposal, and an inspector with a working party was available for permanent repairs.

At the same time it was arranged that the telegraph section should repair two of the railway wires—one for the army, one for the railway.

Lord Methuen's column consisted of 7½ battalions of infantry, forming the Guards and 9th Brigades, two batteries field artillery, 9th Lancers, some M.I., and a Naval Brigade of about 350 men. His orders were to communicate with the Kimberley garrison, so as to enable men and stores to be sent there.

The column advanced early on the 21st, and located the enemy at Belmont. Their position was reconnoitred on the 22nd, and carried early on the 23rd.

The telegraph section moved forward with the train, repairing two

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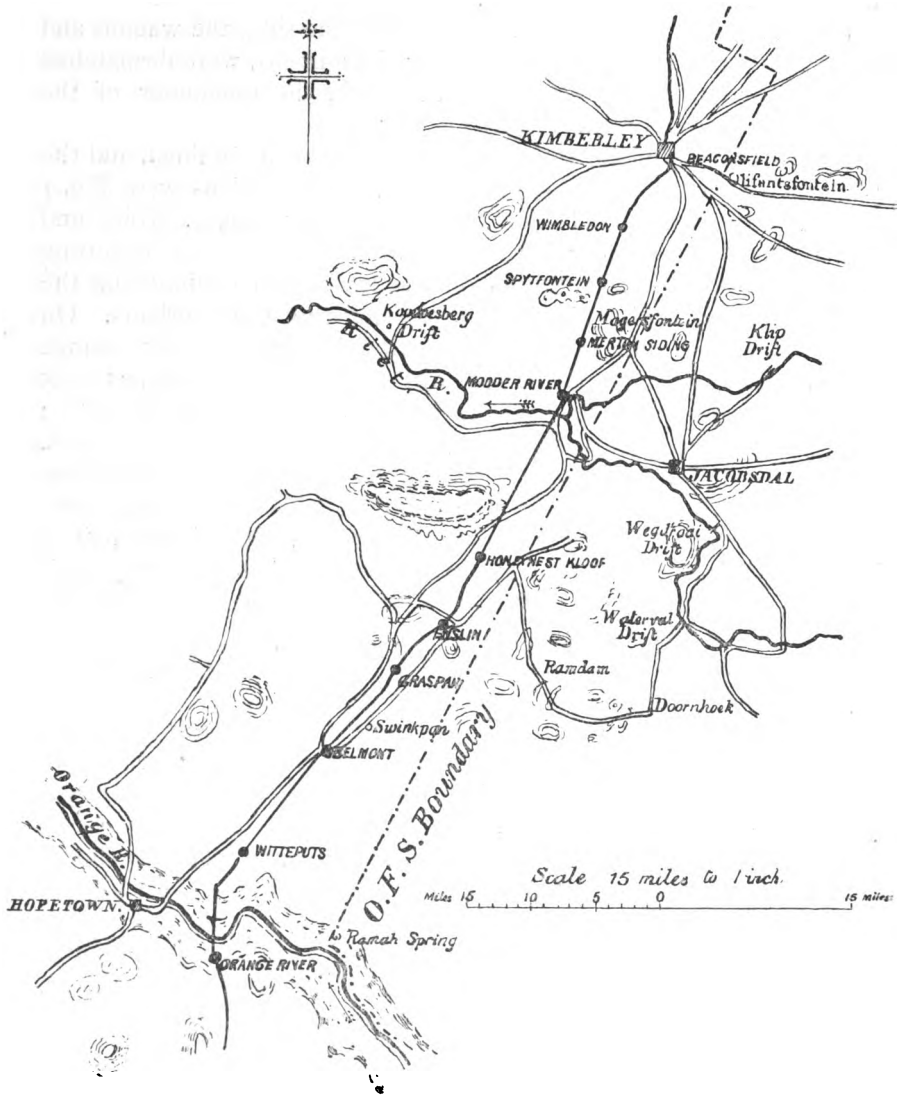
wires of the railway telegraph line wherever it had been broken by the Boers. This was tedious work, necessitating the straightening and staying of the poles at each end of a gap, and the filling in of the gap itself with two parallel lines of air line. It was made especially arduous, as all poles and stores had to be carried from the railway truck by hand; moreover, the ground was very hard. In spite of these difficulties, 4 miles were run in gaps on the 22nd.



On the 24th the column marched to Swinkpan, and early on the 25th carried the Graspan position, bivouacking for the night at Enslin. The telegraph section worked as before, putting in 1¼ miles of double

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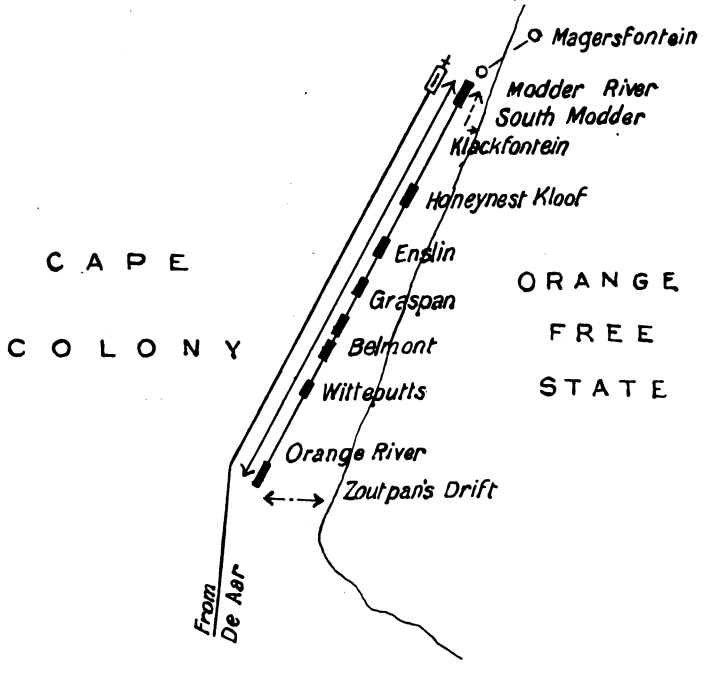
line on the 24th, and about 2½ miles on the 25th. The 26th was a day of rest for the column; but the telegraph section erected some 2½ miles of double air line.

The march was resumed on the 27th to Witteputt, 1¼ miles being filled in with air line. On the 28th the column fought the unexpected battle of Modder River—1 mile of air line was erected by each detachment. Next day 3 miles of double line were completed to the left bank of the river. On December 1st the lines were swung across the river, air line run into Modder River station, and the station telegraph office opened.

ADVANCE TO MODDER.

Scale—20 Miles to an Inch.



Thus far all that could be done was to keep up fairly continuous communication with the rear by dint of the greatest physical exertion on the part of the detachments, and this only because the enemy had destroyed the railway telegraph lines in the most perfunctory way. No attempt at any tactical work was possible.

A pause now occurred before the attack on the Magersfontein position on the 10th. This was utilized to organize the lines, Henrici with No. 2 Section taking over the maintenance in rear, and Jelf with No. 1 Section running up a third line. Leave was also obtained to bring up the transport of No. 3, which arrived on the 6th.

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The Wheatstone sets were got to work between Modder River and De Aar, exercising a magical effect on the tremendous mass of messages constantly arriving by despatch rider from Kimberley.

Considerable trouble was given by Boer raids on the line in rear, in which the wires were cut. The Cape telegraph party, which was repairing the wires permanently in rear, also added inadvertently to the difficulties of good communication.

The section being now complete was able to take a more enterprising part in the advance on the 10th. Lord Methuen's plan was to leave the railway and break through the left flank of the Boer position at Magersfontein, and then turn the left flank of the next position at Spytfontein. A cable cart with 8 miles of cable therefore accompanied the advance of the 10th, 4½ miles of air line being run at the start to save cable. This air line was run by the combined air line and cable detachments, the wire being run off the cable cart and the jumper parties doubled. By this method it was perfectly possible to keep pace with the infantry advance.

The defeat at Magersfontein completely stopped the advance of the column, and during the next six weeks there is little to record.

The Magersfontein casualty report—a message of some 6,000 words—was despatched in an hour and three-quarters after it was handed in, thanks to the Wheatstone. A circuit of eight vibrators was erected to connect up the Modder River defences; and good work was done on 1st January with a cable cart accompanying a column to the west, which was thus enabled to keep in close touch with another column based on Belmont. This last column advanced along the existing telegraph line to Douglas, and was kept in touch by a small party under Henrici.

The Section worked very hard against most heart-breaking difficulties—no transport, dry and hard ground, and little communication with headquarters. Yet it always managed to open an office at or near the Division, and to get the work off.

The circumstances absolutely precluded any tactical work, and this was little required at Belmont and Graspan, as the front covered by the column was comparatively small.

The working of the railway wire by vibrators was unsatisfactory, and led to the separation of the railway telegraphs from the army telegraphs. Better provision for this work now exists in the shape of railway telegraph sections, which are mobilized with the L. of C. telegraph company. The work requires considerable knowledge of special railway requirements, and it is doubtful whether even yet sufficient attention is being paid to the training of officers and men for this important duty.

A bright spot among all the difficulties which attended the telegraph

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service in this episode is the successful use, for the first time in warfare, of the Wheatstone automatic. The provision of the apparatus and of specially trained operators from the Post Office Reserve had been specially arranged on the initiative of Colonel Wrottesley, who commanded the 1st Telegraph Division on mobilization, but was unfortunately drowned on the voyage out. The Wheatstone is a mechanical appliance worked by clockwork, capable of sending up to 500 words a minute on really good lines. It is fed by slip, on which the messages are punched by a number of operators, and at the receiving end the Morse code is automatically printed on a similar slip, which is then written out by another staff of operators. Its effective action has been referred to above—200 words a minute were obtained at Modder River station.

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THE ELECTRICAL SCHOOL AT THE S.M.E.

By LIEUT.-COLONEL B. R. WARD, R.E.

THE first application of electricity to military purposes would appear to have been in connection with lightning conductors and the destruction of wrecks.

A series of regulations of the 4th of August, 1829, laid down the system to be followed for the protection of magazines from lightning. It was not until 1858 that these regulations were reconsidered, and Circular Memo. No. 260, of the 25th May, 1858, was issued by Sir John Burgoyne as Inspector-General of Fortifications. This Circular Memo., prepared "owing to the progress of electrical science during the last 30 years," will be found on page 196 of the *Monthly Army List* for July, 1858.

In February, 1825, Colonel C. W. Pasley, R.E., carried out the first experiment in firing a charge under water. This was ignited through a tube (probably of lead). In 1837 and 1838 Colonel Pasley succeeded in destroying two wrecks—the *William* and *Glamorgan*—which for some years had obstructed the Thames. These also were fired by mechanical means, but the advantages of electrical firing were recognized.

On 10th April, 1838, Colonel Pasley read a Paper at the Institution of Civil Engineers on "Blasting by Galvanism." Daniell's battery, then just invented, was at that time being used as a firing battery, and the first submarine charge to be fired by electricity was exploded on the 17th September, 1839, against the wreck of the *Royal George*. Many other wrecks were similarly dealt with in subsequent years.

Some years afterwards electricity began, tentatively, to find a place in the R.E. Establishment at Chatham. Thus in the *Synopsis of the Course of Military Instruction at Chatham*, issued by Sir Harry Jones as Director in 1853, we find a reference on the first page to "Telegraphing" and the "Use of the Voltaic Battery" sandwiched in between "Escalading" and "The Use of Diving Helmet."

The science of electricity had, it would seem, obtained a footing as one of the subjects to be taught by the Instructor in Fortification just before the Crimean War broke out in the following year; and the value of telegraphy had been sufficiently established for a single-needle telegraphic apparatus to be included amongst the earliest stores that were forwarded to the seat of war.

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Thus in the *Official Account of the Engineer Operations*, Part I., page 153, Capt. J. W. Gordon, R.E., in reporting the wreck of the screw transport *Prince* in the outer harbour of Balaklava on the 14th November, 1854, states that she had on board one sergeant and three men of the Royal Sappers and Miners, as well as the civil diver—Mr. J. Gordon—and Mr. Orchard, attached to the galvanic apparatus. The latter apparently was intended for clearing the wrecks of the Russian ships in the harbour.

Before the close of the Siege of Sebastopol 21 miles of wire had been laid and eight stations established in the Crimea. As a result of the experience gained in military telegraphy in the campaign, the study of telegraphy, photography, and scientific subjects generally was ordered to be carried out at the R.E. Establishment under a special instructor. This group of subjects came to be designated "Special Schools," or, more shortly, "Schools."

Thus we find from *Jackson's Woolwich Journal* that in 1856 Capt. H. Schaw was "In charge of Schools, Electric, Telegraphic, and Photographic Apparatus." This appointment—which was held by Schaw until 1864—may possibly have been held by him prior to 1858. His successor, Capt. R. M. Parsons, was known as "Superintendent of Schools," an appointment which he held for two years, whilst in 1866 and 1867 it was held by Capt. R. H. Stotherd.

From 1867 to 1883 the holder of the appointment was known as the "Instructor of Telegraphy." From 1883 to the present date the title has been "Instructor in Electricity."

The question of submarine mining, which was prominently brought to the notice of the world during the American Civil War (1861–5), became a practical question in England in 1863. A memorandum of Sir John Burgoyne to the Secretary of State for War in July of that year led to the formation, in the following September, of a committee, appointed jointly by the Admiralty and the War Office. Lieut.-Colonel A. A'C. Fisher, R.E., who was a member of this committee, conducted a series of experiments at Chatham in order to determine the best system of mine defence.

The "Floating Experimental School" at Chatham was established by General Simmons in 1866, and was located in the Medway on an Admiralty mooring-lighter. It was placed in charge of Capt. R. H. Stotherd, the Superintendent of Schools at that time, and in 1868 Sir Francis Head, when visiting the R.E. Establishment, was present at an explosion of a submarine mine, carried out by him from the Floating Electrical School.*

The Electrical School, as distinct from the Floating Electrical School, was conducted by the same officer, and appears to have been entirely concerned with telegraphy and demolitions.

* The *Royal Engineer*, p. 130.

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The officers' course in 1868 lasted only a few weeks. The course for N.C.O.'s and sappers, which was intended to turn out skilled manipulators, lasted six months.

The course itself comprised :—*

(*a*). The theory and general principles of electricity and its application.

(*b*). The construction and use of electrical telegraph instruments, batteries, and apparatus.

(*c*). The transmission and receipt of messages ; the construction and erection of permanent telegraph lines ; the application of tests ; and the detection of faults.

The instruments in use at the R.E. Establishment in 1868 were the single needle, the double needle, the Morse sounder, and the magneto-dial telegraph.

An Assistant Instructor in Telegraphy—Lieut. S. Anderson—was appointed in 1868, and in the same year Major F. Bolton, of the 12th Regiment, was acting as Assistant Instructor in Army Signalling. Sir Francis Head, in the *Royal Engineer*, pages 227 to 245, gives an interesting description of flag and lamp signalling as devised by him.

From this date the science of signalling for military purposes was gradually developed in the Telegraph School, first under Capt. F. A. Le Mesurier, and then under Capt. J. C. L. Campbell, until 1876, when it became a general army qualification. But it continued to be taught to all R.E. officers, and Chatham certificates of signalling were issued till 1884 or 1885.

In 1871 electricity, submarine mining, chemistry, telegraphy, photography, photo-lithography, and signalling were taught by the Instructor of Telegraphy and his assistants.

A drawing of the service telegraphic apparatus, as used in 1873, is given in the *Telegraph Journal* of the 15th March, 1873, Vol. I., page 87. The apparatus was contained in a case $13'' \times 8'' \times 7''$, and weighed 25 lbs.

By 1871 submarine mining had become a subject of sufficient importance for an Assistant Instructor to be specially allotted to it. Lieut. R. Y. Armstrong was the first Assistant Instructor for the subject. In the same year the first Torpedo Company was formed, the 4th Company, R.E., being selected for this purpose. From 1873 to 1883 the instruction of N.C.O.'s and men of the Torpedo Companies was carried out on board an old battleship—H.M.S. *Hood*—which was moored in the Medway near the left flank of Chatham Lines. In 1875 the officers' course in "Electricity, Telegraphy, and Submarine Mining" lasted 36 days. In 1883 the *Hood* was abandoned, and the companies at Chatham moved into St. Mary's Barracks, the instruction of officers, N.C.O.'s, and men being transferred to new school buildings at Gillingham.

* The *Royal Engineer*, p. 111.

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In 1884 the number of Submarine Mining Companies in the Corps had risen to five, and the companies at Chatham (the 23rd and 27th) were given a battalion organization under the title of the Submarine Mining Battalion. Major R. H. Vetch was the first officer appointed to command this battalion, with Capt. C. V. Wingfield-Stratford as Adjutant. The officer commanding the battalion was made generally responsible for the instruction of officers and men in submarine mining, and the instruction was separated from the Electrical School. In 1886 the first Instructor in Submarine Mining (Capt. A. T. Preston) was appointed, and the number of Assistant Instructors was in the same year increased from one to two, with, in addition, one (so called) temporary Assistant.

The course of instruction in submarine mining for officers lasted 155 days, but it did not form part of the regular S.M.E. course.

The recruits' course for N.C.O.'s and men on being first posted to the Submarine Mining Battalion lasted six months, two months being allowed for further training in rough water at Portsmouth for recruits trained during the summer months.

Special courses were also held for trained submarine miners in "Fitting and Testing" and for "Engine Driving for Submarine Mining Purposes."

The instruction in this course included a general knowledge of steam, engine driving afloat, and engine driving for electric purposes. The last item of this course was carried out by the Instructor in Electricity; the remainder was under the supervision of a retired naval officer, Mr. J. Parry.

From 1892 onwards the requirements of the submarine mining service had outgrown the capacity of the Gillingham School, and new Schools were opened at Portsmouth and Plymouth.

From this time onward the Submarine Mining School at Chatham was considered as being attached only to the S.M.E.

The title of the officer in charge of each School was at the same time changed to that of Chief Instructor. Shortly afterwards the Submining Battalion organization was abolished.

To revert now to the electricity course proper. By 1887 the officers' course had been lengthened from 36 to 54 days.

At this time a certain number of officers were selected for special courses of instruction in electric lighting and firing mines. The course lasted 70 days. Part of the course—15 days—was carried out in conjunction with the Instructor in Field Fortifications, and comprised the use of mines and explosives. Another part of the course—14 days—was devoted to the use of steam for the electric light. This part of the course was carried out by the Officer in Charge of Workshops. The remaining 41 days were allotted to the Instructor in Electricity. In 1903 the electrical course was reduced to 14 days.

The Electrical School was originally situated in the R.E. Institute,

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but in 1885 it was removed to St. Mary's Barracks, where it remained until the end of 1907, when a move was made to the new Electrical School. The new School was constructed at a cost of about £40,000, from designs by Major E. C. S. Moore, who supervised its erection until his death in February, 1904, after which date Colonel A. Hill was appointed to carry out the work until its completion. To Major F. Baylay, at that time Instructor in Electricity, must also be ascribed a very considerable share in the details of the designs.

The necessary funds were originally provided by the Admiralty as part of an agreement with the War Office, which included the surrender of St. Mary's Barracks to the Naval authorities. Changes in Naval policy, however, were responsible for the transfer falling through, and ultimately the cost of equipping the new building with machinery and fittings was provided from Army funds.

The new Electrical School forms a conspicuous pile of buildings facing the Lines, some 200 yards in rear of the R.E. Institute. Its extent, design, and equipment furnish a striking testimony to the increasing importance now attached to electricity in the training of the officers, N.C.O.'s and men of the Corps.

The abolition in 1905 of submarine mining led to the closing of the Submarine Mining School at Gillingham and the concentration of all defence electric light instruction at the Schools at Portsmouth and Plymouth. This left the instructional accommodation in the new building somewhat in excess of the present electrical requirements, and the opportunity was therefore taken of effecting a much needed improvement in the accommodation of the Construction and Fortification Schools, by transferring the latter to the new building.

The important part now taken by electricity in military science has recently been practically recognized by extending the young officers' course from 14 to 74 days. Courses for probationary mechanist electricians and for line telegraphists have also been re-instituted. The instruction in telegraphy and telephoning is continuous throughout the year.

In addition to the usual instructional equipment, the new School comprises a small generating station of approved modern design, from which electrical energy is distributed to the S.M.E. workshops, the R.E. Institute, etc.

It is just 50 years ago that the Circular Memo. No. 260, referred to in the second paragraph of this article, was issued by Sir John Burgoyne. The same half-century has witnessed numerous and important developments in every branch of scientific activity, but to electricity must undoubtedly be awarded the palm for rapid and uninterrupted progress.

Amongst the various officers who have held the appointment of

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Instructor in Electricity, reference may be made to Capt. R. Y. Armstrong and Capt. P. Cardew.

The former officer is probably best known for his work in connection with the submarine mining service at Chatham from 1871 to 1883, and at the War Office from 1886 to 1891, but in addition he was in the first rank of the electricians of his day, and from 1883 to 1885 he was Electrical Adviser to the Board of Trade, where he laid the foundation of the regulations which now govern the supply and distribution of electricity in the United Kingdom.

Capt. P. Cardew specially distinguished himself by his electrical inventions. An account of some of these inventions is given in Major-General Porter's *History of the Corps*, Vol. II., page 195. Amongst others he mentions his vibrator system of telegraphy and the volt meter, for which he was awarded a gold medal at the Inventions Exhibition.

Major Cardew retired from the service in 1894, and is now one of the partners in the well-known electrical firm of Preece & Cardew.

The following officers have occupied the position of Instructors in Electricity and Submarine Mining since the introduction of the subjects into the S.M.E. curriculum 50 years ago :—

IN CHARGE OF SCHOOLS AND ELECTRIC TELEGRAPH AND PHOTOGRAPHIC APPARATUS.

2nd Capt. H. Schaw	1858-1864

SUPERINTENDENTS OF SCHOOLS.

Capt. R. M. Parsons	1864-1866
„ R. H. Stotherd	1866-1867

INSTRUCTORS OF TELEGRAPHY.

Capt. R. H. Stotherd	1867-1871
„ E. D. Malcolm	1871-1876
„ R. Y. Armstrong	1876-1883

INSTRUCTORS IN ELECTRICITY.

Capt. P. Cardew	1883-1889
„ R. L. Hippisley	1889-1891
Bt.-Major A. H. Bagnold ...	1891-1896
Major G. A. Carr	1896-1901
Capt. F. Baylay	1901-1906
„ C. W. Davy	1906-

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ASSISTANT SUPERINTENDENT OF SCHOOLS.

Lieut. S. Anderson	... ...	1867

ASSISTANT INSTRUCTORS IN TELEGRAPHY (AFTERWARDS ELECTRICITY).

Lieut. S. Anderson	... ...	1867-1871
„ W. De W. Abney	...	1871-1875 (title changed to Assist. Instr. in Chemistry, Dec., 1875)
Capt. R. G. Scott	... ...	1875-1877 (temp.).
Lieut. P. Cardew	... ...	1878-1883
„ G. A. Carr	... ...	1883-1886 (lent to S.M. School from Jan., 1885)
Capt. R. L. Hippisley	... ...	1886-1889
„ W. F. Hawkins	... ...	1889-
„ A. M. Stuart	... ...	1889-1894
Lieut. A. H. Dumaresq	... ...	1894-1900
„ A. D. Carden	... ...	1900-1905
„ A. E. Davidson	... ...	1905-
„ H. E. F. Rathbone	...	1905-1906 (temp.)

ASSISTANT INSTRUCTORS IN SIGNALLING.

Capt. A. F. Le Mesurier	...	1868-1873
„ J. C. L. Campbell	... ...	1873-1876

SUBMARINE MINING SCHOOL.

INSTRUCTORS IN SUBMARINE MINING.

Capt. A. T. Preston	... ...	1886-1891
„ H. B. Roberts	... ...	Acting for six months.

CHIEF INSTRUCTORS, SUBMARINE MINING SCHOOL.

Capt. G. A. Carr	... ...	1892-1896
„ W. Baker Brown	... ...	1896-1901
„ G. P. A. Acworth	...	1901-1905 (School closed, Sept., 1905)

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ASSISTANT INSTRUCTORS IN SUBMARINE MINING.

Lieut.	R. Y. Armstrong	1871-1876
„	J. T. Bucknill	1876-1877
„	G. Barker	1877-1881
„	H. W. Renny-Tailyour ...	1879-1880 (temp.)
„	R. M. Ruck	1881-1885
„	H. N. Dumbleton ...	1885-1890
„	G. A. Carr...	1885-1886 (lent from Electl. Sch.)
„	W. Baker Brown... ...	1886-1888 (temp.)
		1885-1888 (temp.)
„	F. R. Reynolds	1888-1891
„	H. B. Roberts	1888-1891 (temp.)
„	E. Seaman	1890-1896 (for Brennan Torpedo)
„	W. G. Lawrie	1890-1892 (transferred to Plymouth School, 1892)
Capt.	H. B. Roberts	1891-1896
„	G. P. A. Acworth... ...	1896-1900
„	C. B. Collins	1897-1900 (for Brennan Torpedo)
Lieut.	G. E. J. Durnford ...	1900-1905

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HEAD COVER.

By MAJOR A. L. SCHREIBER, D.S.O., R.E.

THE question of head cover is a very old one, and it may be thought that the subject has been sufficiently thrashed out, and that there is little more to be said in the matter.

My chief object in writing is to express an opinion generally adverse to the loophole for field defences, and as it has struck me that this form of head protection has been very much *en evidence* since the South African War, there may be some advantage in drawing further attention to the matter.

Very probably, it is true, most of these loopholes have been made merely for practice in their construction; still, I am inclined to think that in the Army generally they are looked upon as rather necessary appendages to field defences—to be used somewhat indiscriminately. Their construction, apparently, is thought to show a mastery of the art of field fortification—in the same way that up to quite recent years the annual making of a single-lock bridge was supposed to convey a complete knowledge of the mysteries of military bridging. In any case, I feel pretty sure that the question of head protection in fire trenches or fieldworks, does not receive the attention that it deserves, and its vital importance is not appreciated.

On first considering the subject, the nomenclature is found to be vague and inadequate. In the *Manual of Military Engineering* there is a section called "Head Cover and Loopholes," and it is stated that head cover "will usually be obtained by making notches in the parapet for the rifle, or by loopholes." If loopholes form a means of head cover, why is part added to the whole in the name of the section? and, as I shall show later, apparently head cover is at times only taken as referring to loopholes. Also, a "notch" is not a very technical phrase, and we have no proper word to express what is here meant by it; in old fortifications, it was called a "crenellation," or, more correctly, a "crenelle," but these expressions have died out. "Embrasure" is the term we really want, but that is only conventionally used for guns, and not for rifles. I only touch on this point as there really is some difficulty, when discussing this subject, in the paucity and uncertainty of the phraseology.

The comparison to be discussed is between the loophole, the

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"notch," and the plain parapet, and this may be done under five headings.

1. Concealment.
2. Protection.
3. Field of view.
4. Labour.
5. Moral effect.

(1) and (2). The first two must be taken together, as they depend so much on one another.

The question of concealment is really the main point, and my contention is that, except in abnormal surroundings, where the hiding of any defences becomes so easy that the extra protection is hardly necessary, it is almost impossible to conceal ordinary loopholes within shrapnel and rifle range.

By "ordinary loopholes," are meant those constructed chiefly of sandbags or soft material, even though the top is supported by some stiff substance, which is almost a necessity. It is these that are generally referred to in this discussion.

If hard, suitable material is obtainable, such as iron or stone, head protection can be made fairly secure, and concealment may not be of such vital importance; but with any material the only really reliable method is to have iron or steel loophole plates, as these give all the advantages requisite for the other items—protection, field of view, labour, and moral effect.

Conversely, if the parapet is so exposed that concealment is out of the question, then the essential factor is to have hard, bullet-resisting material immediately round the opening. It may sound mere pedantry to say all this, but it is extraordinary how in practice the principle is neglected.

The importance of hard material is almost equally necessary in the formation of notches, and, in their case, even more often disregarded. Within the last two days—since I thought of writing on this subject—I have seen this principle absolutely ignored, first in a fire trench in sand with notches or embrasures scooped out, giving little head cover and a poor field of view, while close at hand were lying unused blocks of stone, quite large enough to protect the head, and of exactly the same colour as the sand. If only even one of these stones had been placed on the left of each notch, what a difference it would have made! The background would have prevented any hard lines of the stone from being visible. In the other case the fire trench was on a rough slope—hardly visible at any range—and notches were made in the earth, some being partly revetted with small stones; and again there were small rocks lying near, which, even if used alone, would have afforded infinitely better protection.

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The saying of the Boer is not sufficiently well known, when he stated that he could always tell the British soldier from a Boer—"the one looks over the rock and the other round it." Here we have one of the fundamental principles of what I am trying to express.

If the head cover is small, the necessary factor is to get close to it; of course, when bullets are flying past, the natural tendency is to keep as low as possible, but all the same, the importance of teaching men to obtain cover in the right way is very essential. All this is mentioned in *Infantry Training*, and I have quite recently seen in a daily paper that the Army Council are taking steps to have cover made near all barracks, so that troops may be easily practiced in this very matter.

It is not generally realized that if a small block of stone, 7 inches cube, is placed on a parapet just on the edge above the elbow rest, and a man fires close round its right-hand corner to the front, his head—I am not speaking of his helmet or hat—is practically hidden, except just his right temple, which would be equally exposed if firing through any loophole, except one with a steel plate. If he fires a little to his right front, he is entirely protected from frontal "decisive" rifle fire. Make the stone 9 or 10 inches high, and he will be protected from frontal "long" range rifle or "effective" shrapnel fire. If the stone is a foot high, he will be sheltered from any except extreme range or high-angle fire. If he is only firing from behind a single stone, it is true, he will be considerably exposed to oblique fire; not so much if there is another stone on the other side of his rifle, forming a notch, but in any case, of course, not as well sheltered as by a loopholed parapet; there is, however, a vast difference between concealing a block of stone—say by tufts of grass or sods—and the top front line of an ordinary loophole standing about 2 feet above the parapet with a dark bull's-eye, marked, as a rule, by its own shadow.

If the elbow rest is not continuous, but is only made at each notch with just sufficient room for a man to fire comfortably, he will be fairly protected against oblique fire.

Comparison between a "notched" parapet and a plain one is more difficult, and in the first category must be included, for want of a better classification, any head protection from a single stone to a scooped-out embrasure, in fact, any kind that has no protection over the top of the rifle.

While there is no doubt as to the protection given, the question of its use depends on the material available, and more particularly on the immediate surroundings, although often, with a little ingenuity and common sense, a notched parapet can be made almost as invisible as a plain one. Any hard line or shadow can be obviated, temporarily, by stopping the notch with sods or other material when not in use.

If the site is not adaptable, then let means of head protection, such as blocks of stone or sandbags, filled, for choice, with small stones,

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be kept in the trench for use, when the enemy is so close that the advantage of invisibility has ceased to exist.

(3). With regard to the field of view, obviously the advantage lies with the plain parapet, and in the case of notches, or loopholes, this depends very much on the material available and the skill used in adapting it; but the notch would certainly have the advantage, as the parapet required to support the loophole covering must be more cumbersome.

(4). The question of labour is not a very important matter, except in hurried defences, but the time occupied in making loopholes, especially with inferior material, might be well employed in improving or extending the trench. If the width of the position is ample for the number of men available, the number of casualties would naturally be reduced by the extra length of trench, so that the men may be placed at greater intervals.

(5). The moral effect is a difficult matter to judge, and about this opinions will probably continue to differ. A very general idea is that the moral effect of loopholes is good, and it is not doubted that they give a comfortable, safe appearance to a trench; but how does the case stand when bullets begin to fly *through* the loopholes? Will there not be difficulty in making a man fire through his hole properly?

All the near bullets will be stopped except those coming through the small opening where each man will have to fire, and one knows how a particular spot where bullets are known to come is avoided; whereas in the case of notches or open parapet it gives a man confidence to hear bullets whizzing quite near without his being hit, and it is extraordinary the hail of bullets that may pass, and yet cause few casualties.

However, this matter is very problematical; but it seems that a loophole parapet may be too comfortable.

The general principles of field defences are given distinctly in our text books, and the general importance of concealment is strongly impressed, but not as regards the actual hiding of head cover.

Since the South African War attempts are certainly made at "landscape gardening," but generally in rather a perfunctory manner. It is rather a general idea—outside the Army at least—that we learnt all these things from the Boers, the real fact being ignored that the South African War was the first in which smokeless powder was used against us. It is not denied that we had to learn, and did learn much from the real Boer, as in the case quoted above, and this because he was a born hunter, to whom the art of concealment and quickness of sight had become almost natural instincts.

The necessity of concealment had been mentioned in text books prior to the war, but it is doubtful if any realized, till after actual experience, the full effect of heavy rifle fire from an unseen foe; then only was the possibility of remaining hidden fully understood, and

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the enormous superiority, both actual and moral, acquired thereby was forcibly impressed on our Army. In fact, the power of smokeless powder has revolutionized warfare as much as the increased range of modern weapons.

Exactly the same experience has been gained in the war in Manchuria, and I have recently read a report, which shows the result of the combined experience and careful thought of the Japanese.

The whole of this report by Colonel C. Hume on a Japanese camp of exercise, near Gotenba, Japan, in April and May, 1907, is well worth studying, and whenever trenches are mentioned great stress is laid on their being rendered invisible, and details for doing this are carefully given. The following sentence is quoted more than once :—"The lie of a position once known, half its value is gone."

He states that except where loopholes were constructed for practice, or experiment, head cover was conspicuous by its absence until the final stage of the attack.

Sandbags were placed in the trenches in the evening preceding the dawn at which the assault was expected. When night fell, these were put up on the parapet and loopholes formed.

"The Japanese argue that the provision of head cover enables an enemy to trace the line of a trench at a distance ; and though they quite realize the value of head cover, they set a far greater value on invisibility, and therefore defer the addition of head cover, until the enemy approaches so close that further attempts at concealment are useless."

Colonel Hume then mentions an experiment carried out by a company of infantry, posted in the advanced trenches of the attack, against a section of trench, part of which was provided with loopholes, and the remainder without head cover. The distance was only between 200 and 300 yards, and the firing took place by day.

The result was that where there were loopholes the infantry had definite points to aim on, and every dummy behind the loopholes was hit. In the other part of the trench only about 50 per cent. of the dummies were touched.

As Colonel Hume in speaking of head cover evidently referred to loopholes only, I wrote to him asking whether the Japanese had used the "notched" parapet, and he has just informed me that no experiments were made with it at the Camp of Exercise, and he only remembers one case of its being used in Manchuria, and that in an unimportant trench at the Battle of the Shaho—being a portion of an entrenched rallying position which was never used.

It was, however, placed on the skyline, and was strikingly conspicuous.

It would be interesting to know whether any other officers saw cases of its employment in Manchuria.

I still believe that it is often a happy medium which can combine invisibility with fairly efficient head protection.

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TRANSCRIPT.

FIELD FORTIFICATION IN THE RUSSO-JAPANESE WAR.

From the *Mitteilungen über Gegenstände des Artillerie-und Geniewesens*, January, 1908.

A SHORT time ago an officer of the Russian Engineers, who served throughout the whole of the Manchurian campaign, published a book on *Types of Fieldworks Constructed During the Russo-Japanese War.*

In this book are embodied the conclusions arrived at from the experiences of the campaign, and the close and careful study is evidenced by the fact that it has appeared over two years after the war was at an end.

The following is a *résumé* of its contents:—

1. INTRODUCTORY.

The principle of protection against outflanking and enveloping movements was observed in this campaign by a great extension of the flanks; in conjunction with strong defensive works in the centre.

The confidence felt in this system of defence was, however, not sufficient to overcome the natural inclination to take up a needlessly extensive position. Consequently the reserves available were generally insufficient; and supporting works were constructed as a subsidiary means of re-assembling the widely-extended troops, in the event of a defeat.

It is noteworthy that the author, a Russian, declares himself a decided supporter of a single line of defence, as opposed to multiple lines.

The strain and duration of modern battles have so great an effect on the mental and physical powers of the troops engaged, that it is hopeless to expect that they can offer from a second line of defence, anything like the resistance they showed in the original position.

The practice, adopted at the beginning of the war, of making fire trenches in the front line with a line of redoubts as a second line, was thus found to be useless.

The fire trenches had naturally the best field of fire, and were in the best position generally, and the redoubts had to put up with the second best. It was found that the front line held out to the last, and the retirement of this line upon the redoubts, at so critical a moment, resulted in enormous losses, and could seldom be executed without great confusion. Consequently any serious resistance from the second line was hardly possible.

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The result was that, during the course of the campaign, supporting points were gradually pushed up until they formed part of the front line of defence.

The opinion, hitherto held by the Russians, that "supporting points should be masked and protected by the front line in order to preserve the full effect of their fire for the decisive stages of the fight," was therefore abandoned, and it was recognized that "the true function, of supporting points, was the constant support of the fire trenches, and the active co-operation with them in a determined resistance."

As soon as it was generally recognized that even the temporary occupation of a position involves heavy losses, the principle of a single line of defence was at once championed.

It is, however, very necessary that this principle should be rightly applied, in the endless variety of conditions which different battlefields present; it must not be interpreted too rigidly, but must be regarded as a rule which not only admits, but demands, exceptions under certain circumstances.

2. Firing Line.

At the beginning of the war the Russians thought that trenches for kneeling fire would be sufficient, and attempted nothing better, even when ample time was available; but they very soon learnt to make more complete cover.

The normal dimensions for trenches were as follows:—

Maximum cover from the crest of parapet to the bottom of ditch	6 ft. 6 ins.
Breadth of banquette	1 ft. 6 ins.
Width of trench...	2 ft. 6 ins.

The height of parapet was 2 feet, and was made with a glacis slope, as it was found that changes in slope make works much harder to conceal.

The surplus earth was put at the back and spread, so as not to be seen above the parapet.

After the first few engagements, where shallow trenches were used, the Russians fell into the opposite extreme, and favoured trenches 4 ft. 6 ins. deep, without any parapet. The author does not favour this type because of the increased labour involved, and the frequent contraction of the field of fire.

Moreover, if the earth is scattered by the trench, it may make it more conspicuous than a trench with a parapet. But if the earth is removed, these trenches are extremely difficult to locate.

The campaign produced no definite conclusion as regards loopholes; right up to the end of the war there were found keen supporters of loopholes with their adjuncts of overhead cover, and equally keen opponents of them.

The author considers it definitely proved that head cover does not really afford any protection, but it has a very great moral value, as men will more willingly remain in the trenches, and will fire with greater precision, when head cover is provided.

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As regards revetment, the heavy rains, and the general nature of the ground made revetment of the sides of the trench necessary in most cases.

For this purpose brushwood was generally used, made into continuous hurdlework.

When elbow rests were not provided, a rough rail was fastened to the side of the trench at the right height. This served as an arm rest when firing, and also helped the men to get out on to the parapet when it came to a hand-to-hand combat.

Steps were usually cut in the rear wall of the trench every 10 yards or so.

Traverses were arranged from 8 to 15 yards apart, and were not taken above the level of the parapet, and the top was sloped to the rear to make them less conspicuous. They were about 2 feet wide at the top and 3 feet at the bottom, and were well revetted.

The Japanese made an equally extensive use of traverses, and generally placed them closer together.

The Russians were unable to put their traverses closer—not because the firing line would be too extended, the modern rifle being so effective that a traverse might be put between every man—but because they had to exercise closer fire control over their troops.

In some instances, on this account, traverses were omitted altogether. Yet undoubtedly traverses considerably reduced the losses from high explosives, and also had a good moral effect, as the men were ignorant of the casualties occurring on the other side of their traverses.

The author favours splinterproof cover for all the men, and, if time allowed, this was generally provided.

The trenches themselves were often completely covered in and provided with "continuous loopholes," but this form of loophole was found to be extremely difficult to conceal.

It was noticed that the effect of "Schimose" powder was not nearly as bad as had been expected.

The howitzers firing this explosive were not sufficiently numerous to make it necessary to attempt any special form of cover against them.

Bombproof cover, against even field artillery projectiles, requires so much material that it was seldom attempted; and General Liniewitz ordered that only splinterproof cover should be attempted in the trenches.

As regards drainage of trenches, it was found that the actual rain falling into the trenches was not of much importance, but the difficulty was to prevent soakage from the surrounding ground. Soak pits were not very serviceable for this purpose unless they were at least 6 feet in diameter and 6 feet deep; and it was generally necessary to take the water out of the trench by a channel, although this often meant considerable labour.

Latrines were always placed in separate trenches in rear of the fire trenches, and were provided with overhead cover, and connected with the firing line by communication trenches.

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3. Redoubts as Supporting Points.

The author states that, after the experiences of the campaign, it was universally admitted that the only type of work which can be rightly regarded as a supporting work, is the redoubt.

It is not so long ago since this idea was abandoned, and supporting works, consisting of groups of trenches, came into favour.

This occurred at a time when it was generally believed that the defence could be vanquished, and forced to relinquish its position by direct rifle and artillery fire. As a redoubt offers no better cover against direct fire than a trench, and is, indeed, usually more conspicuous, it was natural that a somewhat stronger form of trench should be regarded as the best type of work for a supporting point.

These premises have, however, been proved incorrect by the experiences of the Manchurian campaign. Fire alone never sufficed to drive the defence from its position.

A retirement from a defensive position was either voluntarily undertaken, in consequence of the position being outflanked, or else it was rendered necessary by the defence being overpowered in a hand-to-hand combat.

Supporting points composed of trenches are very open to enveloping and outflanking movements, and are incapable of offering a strong resistance to a bayonet assault.

Redoubts are the only works which can offer a stubborn resistance to both these methods of attack; and when natural supporting points, such as villages or woods, do not exist, it is the author's opinion that redoubts only will be employed for this purpose.

The profile of such a redoubt would be very similar to that of a trench, but with a deeper trench in rear to provide more cover, and, if time admitted, with a shallow glacis-sloped ditch in front, in which a wire entanglement or other obstacle could be placed, so as to be under the close fire of the defence and screened from the enemy's view.

In addition to this, another entanglement was generally constructed, some 60 yards from the crest line and right round the work.

This latter formed the actual obstacle against assault, and was of greater importance than the one in the front ditch—though this undoubtedly added greatly to the strength of the work.

This was due to the use of hand grenades, etc., as well as other peculiar features which characterized the close attack in this campaign.

Moreover, the men still fire steadily and with accuracy while the enemy is 60 yards away, but, when he has reached the inner obstacle and is practically on the parapet, the defenders become excited and hardly aim.

Supporting works on level ground were, at first, always surrounded by a deep ditch, about 9 feet deep and 14 feet wide.

The Russians, however, soon recognized the disadvantages of such an obstacle which was not under the fire of the defence, and from the shelter of which the Japanese could throw their hand grenades with devastating effect, and they then substituted a shallow ditch, which was practically a continuation of the exterior slope of the parapet.

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When the deep ditch was employed, efforts were generally made to enfilade by counterscarp galleries or some other method, but it entailed so much labour and the expenditure of so much time that the work really became a semi-permanent work.

For supporting works in the front line, instead of in rear of it, the parapet should be kept as low as possible, and, in any case, the banquette should not be above the level of the ground, that is the height of the parapet must be kept under 4 ft. 6 ins.

When supporting points were placed as a second line, and so escaped the preparatory artillery fire, invisibility was of less importance, and the command could be increased if desired. The maximum command actually employed was 7 feet.

It is noteworthy that the importance of invisibility was so clearly recognized in the later periods of the campaign, that loopholes and overhead cover were abandoned, although their value as an aid to accurate shooting was not forgotten. They are, however, so hard to conceal that they almost always disclose the site of the work, and draw an extremely heavy fire on it.

The parapet was usually made with a glacis slope, the portion just in front of the crest line being so graded that a rifle laid on it at night or in a mist would sweep the foreground.

If there were a shallow ditch with an inner entanglement in it, a second step was provided to the banquette, by standing on which the garrison could sweep both the parapet itself, and the inner obstacle in the ditch.

Redoubts were always provided with traverses. For protection from artillery fire these were made 7 feet thick, so as to be proof against field artillery projectiles; if only designed to give protection against rifle fire, they were made 3½ feet thick, and well revetted.

The firing line was taken in front of these traverses so as to be uninterrupted, and the communication trench in rear of them.

Splinterproof cover should be provided for the entire garrison of every redoubt. The arrangement of one large casemate in the middle of the work was not found satisfactory; and at the end of the campaign the general practice was to make small shelters for 8 or 10 men, under the parapet itself.

Care was taken that the floor of the shelters was not at a lower level than the floor of the trenches, as otherwise it soon filled with water in wet weather. Special shelters were provided for the officers and for the telephone, and the water supply was also placed in a shelter. Latrines were usually outside the work, and connected with the gorge by a trench.

The garrisons at first varied from one to four companies for each redoubt.

When General Liniewitz took over the chief command, however, he ordered that redoubts were to be made for two companies, and, in order to strengthen the fire to the front, annexes or wing trenches were added to accommodate one company in each wing.

This arrangement has received a great deal of criticism.

At the same time it must be remembered that these redoubts were largely used as a second line of defence when multiple lines were still in

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favour, and were only garrisoned at the last moment, and then by troops quite strange to the environment. It was, therefore, necessary to make stereotyped works, which were at once recognized and understood.

Had the troops at the last moment entered a complicated labyrinth of trenches, parapets, and shelters, ignorant of the general design of the work, and not knowing whether one or three companies would be a suitable garrison, great confusion would have resulted.

The infantry annexes were connected with the redoubt under the parapet. Obstacles were kept at hand ready to block this entry as soon as the final assault was threatened.

At the beginning of the campaign redoubts, or keeps, were made in the centre of the larger redoubts, but these were abandoned before any actual experience of their merits had been obtained.

4. Villages.

Before the war it was generally thought that villages would be of little value as supporting points, because they offer such slight protection against modern artillery fire.

It was overlooked that field artillery, being designed mainly for use against *personnel*, has very little effect on buildings.

As regards field howitzers, there were but few available during the campaign; the Russian field mortar had not sufficient range, and the Japanese high-explosive shell (Schimose) exploded directly it struck the first wall, and had no effect against the second; consequently it was found that safe cover could be obtained behind every house.

During the campaign villages were very frequently included in the front line as supporting points; but this was largely due to their general design and construction, as every village in Manchuria is protected against Hunchugu raids by a walled enclosure some 2 ft. 6 ins. thick, and provided with bastions at the corner.

The houses have bullet-proof walls and are fairly fireproof, the only inflammable part being the roof, and in many cases even this is covered with a layer of clay.

Villages proved especially valuable when the time available for defensive preparation was very short. All that was necessary was to cut notches in the wall for loopholes, and provide a banquette or firing platform.

The numerous trees, which are to be found in and round the Manchurian villages, formed a natural screen, which prevented the enemy from observing the result of his fire.

This natural screen was always fully taken advantage of by the Japanese, but the Russians in some cases cut down the trees to make platforms, and for fuel, and later were put to great trouble to devise artificial screens.

In the larger villages, the boundary on the enemy's side was taken up as a first line of defence, and one of the stronger house compounds in rear was turned into a keep. A field of fire extending to 50 yards was found sufficient for the keep; and everything within this distance was demolished and carted away. Obstacles were lavishly used both in the front line and round the keep.

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The actual examples of the attack and defence of villages in this campaign, offer nothing new or particularly instructive. They show enormous labour in preparation, several lines of defence, and often two or three tiers of fire in each line. A great deal of the labour of preparation, moreover, was unnecessary and useless.

5. COMMUNICATIONS AND COVER FOR RESERVES.

The frequent searching, with artillery fire, of the ground in rear of the front trenches, rendered it necessary that all movement of troops, wounded, supplies, etc., to and from the front line should be concealed and covered.

Communication trenches, leading to positions on the forward slope of a hill, were extremely visible from the front, even at long ranges; consequently they had to be entirely covered in, the covering material being assimilated to the surrounding ground.

The fire trenches were not laterally connected with each other, as, in the event of the attack obtaining possession of part of the line, it would have been easier for him to extend his hold to right and left. For this reason lateral communication was arranged in rear of the front line. It was found that these communication trenches were a serious obstacle to the movement of troops in war, and, for this reason, they had to be bridged over in many places.

6. COVER FOR ARTILLERY AND MACHINE GUNS.

The field artillery of the defence require three prepared positions:—The first for the artillery duel; the second for shelling the advancing infantry; and the third for dealing with the final assault. The first two will be some distance behind the front line, and can be easily concealed. The last will frequently have to be on a level with the front fire trenches. A choice of several positions should be provided for the first two purposes, as this makes it very hard for the attack to locate the artillery of the defence.

Cover must always be provided for the detachments, as, owing to the rapid consumption of ammunition, it will be found impossible to keep up a continuous fire and long pauses will have to be made at intervals, and, during these, the detachments must be protected from the enemy's fire.

During the Manchurian campaign the artillery detachments provided their own cover, and it is seldom that fatigue parties for this purpose can be provided.

For guns, brought up into the firing line to repel an assault, very stout works, resembling closed batteries, are necessary, and the front must be barred by strong obstacles.

Every endeavour should be made to foresee the assault, and to get these guns in position well in advance, as, when the time comes, the fire of the attacking infantry will be so heavy that it may not be possible to bring the guns up into position, unless covered communication for this purpose is provided, and this involves very heavy work.

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7. Obstacles.

In this campaign obstacles were used on an unprecedented scale; and indeed towards the close of the war they were often misapplied, being erected in places where they could serve no useful purpose, and where they were not even under the fire of the defence.

Before the war it was thought that obstacles would be little damaged by artillery fire, but experience shows that they suffer severely if exposed, and that artillery fire is the quickest means of destroying them. It is, therefore, of the first importance that they should be concealed.

Wire entanglement, combined with large military pits, proved the most effective obstacle.

Abatis were of very little use.

Fougasses had an extraordinary moral effect, but, if worked automatically, are a great source of danger to the defenders themselves. They were usually placed some 50 yards in front of the fire trenches.

8. Scale of Works Constructed.

In order to get an idea of the growth of field fortification, some details are given of the works constructed by the 2nd Army in a portion of the Sipingai position.

Length of Front of Works ot the 2nd Army—24 miles.

1st Line of Defence.—At the foot of the hills, consisting of redoubts surrounded by entanglements, and with fire trenches in the front of and between them.

2nd Line of Defence.—About 800 to 1,000 yards in rear; also redoubts and trenches.

The following works were constructed for this army:—

91 redoubts and 4 lunettes.
60 villages were put in a state of defence.
100,000 yards of wire entanglement, combined with military pits.
165,000 yards of plain wire entanglement.
99 bridges, amounting to 2,600 yards.
250 miles of road.

This programme gives some idea of the enormous *rôle* played by the field fortification in modern warfare.

C. Otley Place.

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NOTICES OF MAGAZINES.

NOTE.

Back numbers, dating from the 1st January, 1907, have been received of the *Boletin del Ministereo de Guerra y Marina*, a journal issued fortnightly by the War Office at Lima. Besides containing a mass of interesting matter, and information regarding the National Army, there are numerous valuable articles on the organization and material of foreign armies, and on military hygiene, geography, tactics, etc. The journal clearly shows the high standard of military knowledge attained by the officers of the Peruvian Army.

MEMORIAL DE INGENIEROS.

October, 1907.

EXPLOSIVES AND THE SAPPERS AND MINERS.—By Capt. D. Carlos Requena.—One of the principal missions of modern engineers, is that connected with the use of explosives and the execution of all kinds of demolitions. In the German Army, an endeavour is made to train all the sergeants and corporals of an engineer company, so that they may be able to carry out, by themselves, all smaller demolitions. The sappers are only taught to make joints, to place the charges, and to have a knowledge of the material used and of the properties and precautions that must be taken in the use of fuzes and explosives. The instruction is almost all of a practical nature, though a few night classes are held for teaching the N.C.O.'s the use of the formulæ and tables of explosives, without, however, explaining how they are arrived at. The results of the instruction are exceedingly good, and military engineers are constantly called in to assist in civil matters, such as accidents on the railways, rivers choked with ice, or when anything occurs to interrupt traffic, and also when walls or chimneys have to be felled.

Capt. Requena was recently attached to a battalion of engineers at Coblence, and took part in some interesting demolitions. He describes, with the aid ot numerous plans and sketches, the blowing up of the church tower at Scherweiler, and of a tower at Weissenburg. In the first case, the party charged with the work consisted of 1 officer, 3 N.C.O.'s,

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and 10 sappers, all mounted on bicycles, on which also were carried all the requisite materials. It left Strasburg at 4.15 a.m. on the 10th July, and arrived at Scherweiler (46 km., or 26½ miles) at 8.15 a.m. Whilst the men were resting the officer examined the tower, which was detached and built of masonry set in lime mortar. Its height was about 92 feet, and the thickness of the walls about 6 ft. 8 ins. On the north and south sides there were houses, the nearest being about 40 feet distant, to the east was an open space, which, however, it was desired to keep clear, and to the west were the ruins of the church, which had already been destroyed. It was consequently decided to cause the tower to fall on the top of the ruins. Ten mine chambers in all were made in the walls at the ground level, and were built up after they had been charged, and 3 feet of earth was then banked up against the walls. In order to prevent stones being blown out and damaging the surrounding houses, a wall 6 ft. 6 ins. high was built up, all round the tower, with the materials of the old church. The positions of the charges, and the amount of explosive in each, were carefully calculated according to the rules given in the official text book, and when they were fired the tower fell exactly as had been intended, and none of the material was blown out. The total time occupied was 14 hours.

MOTOR TRACTION IN OUR ARMY (*continued*).—By Capt. D. Ricardo Goytre.—The two motor cars, described in the last number, were overhauled and partly rebuilt in the regimental workshops, and a number of N.C.O.'s were trained to drive them; they were then placed at the disposal of the Captain-General of Madrid, and of the headquarter staff of the army. The king has obtained the services of four of the engineer chauffeurs to drive his own cars. Last March two new cars were purchased, the one a 35-h.p. Panhard, the other an Itala of the same horse power.

THE DUESO PENITENTIARY COLONY.—By Major D. Lorenzo de la Tejera.—For very many years convicts, sentenced to penal servitude, have been transported to the Spanish possessions on the north coast of Africa, but it has lately been decided to discontinue this practice, and in February, 1907, a commission was appointed, of which Major de la Tejera was a member, to select and report on suitable sites for convict establishments in the Peninsula. The places chosen were the castle of San Fernando at Figueras, close to the French frontier of Catalonia, and the fortress of Dueso at Santoña.

Spanish convicts, on commencing to serve their terms, are placed in solitary confinement for about nine months; they are then put on the public works and are locked up at night; in the third stage they are allowed to live in houses in a semi-free condition, but are forbidden to leave the place (in Ceuta, for instance, many of the waiters in the inns and servants in private families are convicts). This system governed the plans of the Dueso prison, which is to contain 1,000 men. It has been decided to build a central block containing 200 cells arranged on both the ground, first, and second floors, each floor containing a separate class.

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of prisoners, and the severity of the confinement decreasing as they are transferred from the lower to the upper stories. Under normal circumstances three months would be spent in each story. There are also two blocks, each accommodating 300 men of the second class, viz., those who only sleep in the prison but work outside it; and a building is provided for 200 men of the third class. Each building is in the shape of an L. A hospital, chapel, and the necessary offices are provided, and all are surrounded by the old fortifications.

MILITARY REVIEW.—*The War in the Far East*, by the Military Correspondent of *The Times*.—The book is very well reviewed, but the reviewer remarks that the views of the author on the subject of fortification are certainly not shared by English engineers. He quotes the author's observation that when engineer officers reach a high position in the councils of the State, they often become a danger to it, and says that there seem to be no grounds for such an assertion, and that it is a most inopportune one at the present time, when the most distinguished generals of the British Army have come from the Corps of Royal Engineers.

'M.'

REVISTA DE ENGENHERIA MILITAR.

February and March, 1908.

The February and March numbers of the review are combined into one.

THE KING D. CARLOS I. AND THE CROWN PRINCE D. LUIZ FILIPPE.—The deepest regret and sorrow is expressed for the loss suffered by the Portuguese nation and army by the death of the King and Crown Prince, and for the abominable outrage to which they fell the victims. The King, before he ascended the throne, was brought into close personal connection with the Corps of Engineers, as he was a member of the Defence Committee of the port of Lisbon of which most of the members are Engineer officers. He was president of the sub-committee which worked out the defences of the port, and took a very active part in the preparation of its report.

HARMONIC SYNTHESIS OF THE TIDES.—By 1st Lieut. Jayme Wills d'Aranjo, of the Portuguese Navy.—The author gives a short summary of the laws regulating the tides, defines what is meant by harmonic analysis and synthesis, refers to the tide predicter, and then shows how to calculate the height of the water at any fixed time. The paper contains two tables, one of the elements of the most important tidal waves, the other of the composite waves.—*To be continued.*

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SOME PROJECTS AND WORKS EXECUTED IN THE PROVINCE OF MOÇAMBIQUE DURING THE LAST NINE YEARS.—By Capt. Machado de Faria.—The author was Director of Public Works to the Moçambique Company. The first part of this period was marked by great financial and economic depression, and the Governors-General were often compelled to pass from extreme economy to lavish expenditure on provisional works of an urgent nature. It was not until Gaza had been pacified and the Transvaal War ended, that the Public Works Department could be organized on modern lines.—*To be continued.*

A great deal of money seems to have been wasted in providing provisional buildings, which could only last but a short time, instead of permanent ones. Little attention seems to have been paid to the recommendations of the engineer in charge, and his difficulties can be understood when it is stated that within the short period of three years he served under one Royal Commissioner, three Governors-General, and four Acting Governors-General.

The works were as a rule constructed by day labour with materials provided by the Department. Finance was a difficulty, especially as corruption had to be very carefully guarded against.

The following table gives details of some of the works executed:—

Name of the Work.	Total Estimate Milreis.	Number of Square, Cubic, or Lineal Mètres.	Cost per Square, Cubic, or Lineal Mètre.	Mode of Execution of the Work.	Short Description of the Works.
Defensible Barrack at Ilha da Inhaca.	6,000	367 (cub. m.)	16·348	Open tender.	Defensible barrack of rubble masonry in lime mortar, material from the old barracks, walls 1′ 8″ thick, 10′ to 16′ 6″ high, on a masonry foundation, roof of wood and zinc and felt, quarters for 1 company of infantry.
Telegraph Station at Ponta Vermelha.	1,430	102	14·430	Open tender.	Building in the form of a châlet, brick, cement, and sand, roof of wood and zinc, verandas and pavement of mozaic stone, height 11′ 6″.
Iron shed for the Custom House at Lourenço Marques.	16,898	1,440	11·734	Contract.	On a masonry foundation and basement, 3′ 3″ high iron shed, costing 13 contos, 120 m. long, 12 m. wide, in 6 independent compartments, height 11′ 6″, lined with galvanized iron.

THE HAGUE CONFERENCES (*continued*).—A continuation of the proceedings of the 1899 Conference. It contains nothing which is not readily accessible in English.

OBITUARY NOTICE OF GENERAL RODRIQUES GALBERDO.

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REVUE DU GÉNIE MILITAIRE.

February, 1908.

THE BALLOON "PATRIE."—This balloon was practically made to the same design as the "Lebaudy." It was 61 mètres long, and 10·3 mètres in diameter at its greatest cross section, and held 3,250 cubic mètres of gas. One of the principal improvements introduced was a balanced vertical rudder, pivoted towards the centre instead of at the front edge. This arrangement made it much easier to put the helm over, and proved quite satisfactory. Two horizontal planes, one on each side of the balloon, were also added. These were pivoted about their centres, and could be set at any angle. When the propellers were working, the air pressure on these planes induced the balloon to rise or fall. In this way a great saving of gas and ballast was effected. In July, 1907, the balloon was enlarged by adding another longitudinal section to the envelope, thus increasing its capacity to 3,650 cubic mètres. It was then able to attain an altitude of from 1,000 to 1,500 mètres with a crew of four.

The balloon made 43 ascents. Its speed was about 40 kilomètres per hour, and its radius of action about 150 kilomètres. It could rise with safety to a height of 1,500 mètres. The circumstances, under which it was lost, are too well known to be retold here.

THE INFLUENCE OF THE SIEGE OF PORT ARTHUR ON THE CONSTRUCTION OF FORTS.—The conclusion of the previous articles. Judging by the experience of Port Arthur, it seems desirable to have counterscarp galleries to protect the ditch, but the galleries themselves must be protected by a system of countermines. The front wall of the galleries need be only 3 feet thick, but the roof and back wall should have a thickness of 9 feet.

The search lights should be placed on the musketry banquette, or preferably on the covered way if there is one. Small search lights should be provided in the counterscarp galleries to light the ditch when required.

It has been found that a fort cannot be efficiently protected at night by sentries stationed on the parapet. The counterscarp galleries, at Kikwan North and Ehrlong, were captured without the sentries on the fort parapets perceiving the approach of the Japanese. It seems desirable, therefore, to reintroduce the covered way, and to garrison it at night for the protection of the glacis.

A modern fort will usually have about 160 mètres of parapet on the front and flanks. To defend this about 80 men will be required, or, allowing for a reserve, a total of 100. Four reliefs will be necessary, so the total garrison must be 400 men. When the fort is closely attacked it may be necessary to increase the garrison to 600.

The garrison of the gorge should be protected by a parados of the same height a the front parapet, or even higher. This parados should extend to the flanks, and should be joined to the front parapet by one or more traverses built over the underground passages. The

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interior of the fort will thus be divided into a number of small enclosures, and the effects of shells will be localized.

Regular slopes and continuous lines of parapet render a work very conspicuous, and should, therefore, be avoided. Trees should be planted both in front and behind all works.

The author gives three plans, which represent (1) a portion of an ideal fortress; (2 and 3), a type of fort for a garrison of one company (200 men). The latter consists of a work nearly square in trace, the front face being a little shorter than either the flanks or gorge. In the two front corners, are concrete emplacements for light Q.F. guns, roofed in with 4-inch chrome steel plates. Similar emplacements for machine guns are provided in the two rear corners. The flanks, in addition to having an ordinary musketry parapet, are provided with a concrete musketry gallery built in the parapet itself; the gallery is roofed in with 4-inch armour plates, the roof coinciding with the superior slope of the parapet. A continuous loophole exists between the front edge of the roof and the concrete wall. The gallery is provided with 2-foot concrete traverses, 9 feet apart. It is the author's opinion, that the enemy's fire, taking the flanks in enfilade and reverse, will render the ordinary parapet untenable, and he has therefore provided this bombproof gallery, so as to enable the flanks to maintain an efficient fire upon the adjacent intervals.

The interior of the fort is divided into a number of small compartments, by two parados and a central traverse. Both parados are furnished with musketry parapets. The casemates are under the gorge parapet, the windows looking into the gorge ditch. The shelters for the relief on duty and officers' quarters are situated under the front parapet. There are escarp and counterscarp galleries, and a gorge caponier. The counterscarp galleries are provided with embrasures for Q.F. guns, machine guns, and search lights. The galleries themselves are protected by countermines.

The internal communications of the fort are secured by an elaborate system of underground passages, of which the chief are (1) a central passage connecting the casemates with the front parapet shelters, and the escarp and counterscarp galleries; (2) a transverse passage, under the parados, which connects the two flank musketry galleries with the central passage. There are two exits from the central passage behind each parados. An underground passage leads out of the fort, under the gorge ditch, to a hollow in rear. The fort is provided with a covered way.

All concrete roofs and walls which could by any possibility be reached by the enemy's shells are 9 feet thick. The author gives no estimate of the cost of such a work.

March, 1908.

THE SIEGE OF TOUL.—A short description of the siege and capture of Toul in 1870. The fortress was small and out of date, and was commanded at close range by the hills all round. It held out from the 16th August to the 23rd September. The Germans—after assaulting it twice, and then attempting to reduce it by artillery captured from the French—were finally compelled to bring up a Prussian siege train. After

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a bombardment, which lasted 9½ hours, the place capitulated. The losses of the garrison were 115 killed and wounded, out of a total of 2,290. The besiegers' losses were 25.

FOUNDATIONS.—A description is given of an apparatus used for determining the safe load that any particular soil can carry. It consists of a wooden platform sliding up and down between four wooden uprights. It is supported on a vertical wooden post, 64 square inches in cross section, the foot of which rests upon the ground. Weights are placed upon the platform, and the amount that the post is driven in for each increase of weight is measured. Experiments made in this way show that soils, which are of apparently the same consistency, vary greatly in their power of resistance.

INSTRUCTIONS IN SIEGE OPERATIONS AT THE ÉCOLE SUPÉRIEURE DE GUERRE.—In June, 1903, a siege course was started for officers in their second year. It is directed by one engineer and one artillery professor. The course consists of nine lectures; the first three are purely theoretical, the next three discuss the application of principles to a particular case, and the last three deal with a historical example—such as the siege of Port Arthur. The lectures are followed by practical work. As a preliminary to this, each officer is called upon to write an essay on the attack of a given sector of one of the modern French fortresses. Imaginary works are introduced into the data, and the essay writer is left to some extent in the dark as to the details of the enemy's defences. In this way the fog of war is introduced. These essays are then criticized, in class, by the professors. Finally, a practical exercise, lasting four days, is carried out on the ground. For the latter the officers are divided into three groups, two being allotted to the attack, and one to the defence. Each officer is given a command such as O.C. Artillery, O.C. Engineers, O.C. Engineer Park, etc., and is allotted a special task on which he has to write a report. During the last two days the professors go over the whole ground with the class, taking the works in their proper sequence. Each officer reads his report on the site of his proposed work, and the professors make the necessary criticisms. The practical work done each year is explained and criticized the following year, as part of the theoretical instruction of the next class. This course, entailing as it does the co-operation of all arms, has been found to be very valuable as an instructional exercise.

April, 1908.

THE FOREIGN MILITARY ESTABLISHMENTS IN CHINA.—This article gives a description of the various barracks and other buildings erected for the foreign detachments in North China, including the Legation defences in Pekin. The German works are dealt with in the present number. The German garrison consists of 303 infantry and artillery at Pekin, and 430 infantry and mounted infantry at Tientsin. Tongku is garrisoned by a detachment from Tientsin. In the German Legation at Pekin there is accommodation for 336 men. The barracks consist of 14 single-storey

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blocks. The officers' mess and quarters are roomy and very well furnished. All the buildings are fitted with electric light. The barracks were built by Chinese contractors. The author is of opinion that the French system of employing Chinese workmen under European foremen is more satisfactory.

The defence of the south-eastern corner of the Legation quarter is entrusted to the Germans. Their defence works consist of a fortified gate across Legation Street fitted with armour-plate doors, a loopholed wall forming the eastern boundary of the Legations, and a blockhouse on the Tartar city wall. The German wall is prepared for two tiers of fire, and is protected on the outside by a wide ditch. The blockhouse is designed to flank the wall with machine-gun fire. It is, however, commanded at close range by the Ha-ta-men gatehouse, and in the event of hostilities it would be necessary for the Germans to seize or destroy the latter.—*To be continued.*

FIELD TRAINING OF SAPPER COMPANIES.—Suggestions for the tactical training of the French companies of Sappers and Miners. The system advocated is similar to that employed in training British infantry recruits.—*To be continued.*

CLEANSING THE AQUEDUCT AT LAGHOUAT.—This aqueduct brings water from the river to the barracks. The water is collected in a tunnel built of dry masonry in the bed of the river. Heavy floods in 1906 and 1907 laid bare the roof of this tunnel, and swept a great deal of mud into the tunnel and aqueduct. To prevent the further ingress of mud the upper part of the tunnel was rebuilt in mortar, so that the water can only enter by filtration through the lower portion. A breakwater was also built out from the bank to protect the tunnel from the force of the current. These methods appear to have been effective, and the water in the aqueduct is now free from mud, even during the heaviest floods.

J. E. E. CRASTER.

RIVISTA DI ARTIGLIERIA E GENIO.

December, 1907.

AUSTRIA-HUNGARY.

AUGMENTATION OF DETACHMENTS FOR MITRAILLEUSES.—With reference to the orders regarding detachments for mitrailleuses, mentioned in the *Revista* for September, p. 342, a statement is made in the *Neue Militärische Blätter* of 2nd December, that the war administration has decided on a large allotment of such detachments to the troops on the frontiers, so that while formerly each of the three regiments possessed only one detachment of mitrailleuses for mountain warfare, eleven more will now be allotted, one to each of the three battalions of the 2nd Regiment and of the

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4th Infantry Regiment of the Landwehr, and to five of the 1st Regiment of national riflemen.

Each detachment consists of 1 captain-commandant, 2 subalterns, 1 sergeant-major, 5 under officers, 2 section sergeants, 4 corporals, 4 marksmen (appuntati), 24 gunners, 1 trumpeter, and 3 officers' servants, or a total of 3 officers and 44 N.C.O.'s and men, with 3 horses for officers, 8 pack horses or mules, and 4 mitrailleuses (Schwarzloze system). The detachments will be stationed at the commands of battalions (Schlanders, Bolzano, Riva, Trento, Pergine, Cavalese Cortina d'Ampezzo, Innichen, Hermagon, and Klagenfurt), and in the summer will follow the companies. Conforming with the custom adopted for the cavalry saddle horses, the pack animals necessary in event of war will be distributed for private use to the owners of land, etc. For the defence of the south-eastern frontier, the mitrailleuse detachments will prove a valuable reinforcement. Each of the 12 mountain brigades and of the 27 infantry divisions (except the 14th Corps) will be provided with a mitrailleuse detachment. For the Hungarian Landwehr (Honved), new formation of such detachments are not yet provided. The number of 50 detachments (39 for the army of the first line, 11 for the Landwehr) is considered proportionally deficient, as Bulgaria, for example, intends to assign one for each of its 36 infantry regiments.

DENMARK.

VOLUNTEER MOTOR CYCLISTS.—*La France Militaire* of the 16th December has extracts from the *Vorst Forwar*, showing that a corps of volunteer motor cyclists has been organized in Denmark by Sigr. Westenholz, who has placed at the disposal of the new corps, 3 automobiles, 80 motor cyclettes, 80 Rekylgewehre (automatic rifles), with 3,000 cartridges per rifle, all at his own expense.

Each motor cyclist will carry with him an automatic rifle with 800 cartridges; the remainder of the ammunition will be carried in the automobiles.

The corps will have a military organization under a captain of engineers, assisted by a lieutenant. Military instruction will be given by four or five officers of the active army. The rifle range and *place d'armes* at Copenhagen, will be placed at the disposal of the new volunteer corps, where it will go into camp for 14 days' service in each year at the time of the manœuvres.

January, 1908.

ENGINEER SERVICES DURING THE RUSSIAN-JAPANESE WAR.—By Capt. Cardona, General Staff.

BRIDGES.

Most of the water courses of Northern Corea and Manchuria are, for the greater part of the year, either dry or fordable at many points, and the severe winter in Manchuria freezes the rivers, so that they can be crossed on the ice with safety.

Towards the end of March at the commencement of the melting of

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the snow, or in June and August in some rainy stations, the rivers are in full flood, with a great depth of water and swift current, and the low grounds are inundated. The small rivulets may then present obstacles difficult for crossing.

At the commencement of the war the railway bridges were the only means by which the armies could cross the rivers, although the vehicles of commerce crossed by the fords, or by small bridges not strong enough to bear the weight of heavy military carriages.

Russian Army.—Each pontoon battalion had a bridge equipment—divisible into two half equipments—consisting of 104 wagons with 28 boats, which would serve on the average for 218 mètres of bridging, or for a span of 240 mètres. The whole of the bridging material, in the theatre of operations, consisted of bridging equipment for the 1st Pontoon Battalion of Eastern Siberia ; three other half equipments of pontoon companies ; bridge equipment for the 1st European Pontoon Battalion with material on the new system (Schwebzow), and the reserve bridging material. In addition, each sapper battalion had 21 mètres of light bridging equipment on six wagons. As, however, the Manchurian rivers, owing to their width and depth and the condition of their banks, did not allow of the use of these light equipments, they were relegated to the rear of the columns, and formed obstructions to the movements of the troops, especially in the retreat on Liaoiang.

After the Battle of Vafangu—15th June, 1904—the great part of the Russian Army was split up, with one part near Tachicaio and the rest south of Haitcheng ; but it commenced to reunite on the 26th July, about 15 kilomètres south of the last-named village.

Two bridges were constructed for the retreat of the Russians from the position of Tachicaio—27th July—across the Haitcheng-ho, each about 150 mètres in length.

On the 29th July, two other bridges were commenced with materials found on the spot, and were completed on the 1st August. Both these bridges were about 150 mètres in length. Two pontoon companies were employed in the construction of these four bridges.

A great portion of the Russian Army crossed the Haitcheng-ho on the 31st July and the 1st August. On the 2nd August the great part of the Russian Army was in retreat on Liaoiang.

On the 24th August the Russians occupied a line from Antsciantscian (right wing) to the Taitse-ho (left wing) with the Xth Army Corps, at about 23 kilomètres east of Liaoiang. On the 26th to 28th August, still fighting, they continued the retreat, thus necessitating the bridging of the Tan-ho.

On the 29th August their position extended to about 10 kilomètres south of Liaoiang on the railway to Siapu, and the army corps were constituted as follows :—

1st Line.—Ist Siberian, IInd Siberian, Xth Army Corps—left wing.

2nd Line.—Near Liaoiang, IVth Siberian ; south of the Taitse-ho, part of IInd Siberian.

3rd Line.—To the north of the Taitse-ho, XVIIth Army Corps—5 to 10 kilomètres north-east of the left wing of the Xth Army Corps.

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In the region of Liaoiang the following bridges were found or constructed :—

1st. Composed of Chinese boats and passable for all arms, at the hill of Liaoiang behind the Russian left wing.

2nd. Composed of regular boats, 219 mètres long and passable for all arms, at the valley of the preceding. This was constructed by a pontoon company on the 29th August.

A third—3 kilomètres from the preceding—was constructed with Chinese boats, and, taking advantage of an island, the bridges were in two portions, one 175 mètres, and the other 160 mètres in length; these were passable by all arms.

4th. By the side of the railway bridge, passable for all arms; composed of Chinese boats and piles, and constructed by a company of sappers.

5th. One kilomètre from the preceding, composed of regular boats. As there was an island, the bridge was in two parts, one 92 mètres, and the other 67 mètres long, and it was constructed by a pontoon company and was accessible for all arms.

6th. Across a small canal of the Taitse-ho, passable for infantry only.

7th. 2 kilomètres from the fifth; built of Chinese boats, and passable by all arms.

Destruction and Repair of the Bridges.—Between the 3rd and 8th September, the Commandant at Liaoiang received the following orders :

(1). On the 3rd September: "This evening all the troops will retire on Mukden. After the crossing of the last of the troops, the permanent wooden bridges are to be destroyed, and those of other materials are to be dismantled.

"The transporting of the bridges is to be by way of the north. All materials of the reserve bridges, excepting the carriages, are to be destroyed and sunk, if of iron, and burnt, if of wood." Notwithstanding these orders, as much was saved of the materials as possible, but it was not possible to load and transport the fifth bridge of Liaoiang by rail.

All the permanent wooden bridges—as well as the superstructure of the railway bridges—were burnt.

Retreat on Mukden.—The pontoon companies, with their awkward and heavy bridge equipments, were with the rear guard of the Russian Army; their retreat was carried out under great difficulties. The equipments should have been pushed rapidly towards Jantai—22 kilomètres north of Liaoiang—but owing to the scarcity of horses and the wretched state of the roads, they were greatly retarded. For instance, a pontoon company had to advance with part of the equipment for about 5 kilomètres, and then to send back its horses to bring up the remainder; but after 3 kilomètres the horses, which transported the first half of the equipment, were so exhausted, that it was impossible to continue this system. Becoming unserviceable, 18 wagons with equipment, 2 tool wagons, and 1 forge wagon had to be burnt.

Four pontoon wagons, also, had to be destroyed, so as to be able to supply other carts with their horses.

The march was very slow, owing to the bad roads and the want of

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bridges over the water courses. On the 5th September only 10 kilomètres were covered; the day after only 6.

On the 7th September a pontoon company was employed in constructing, with regular materials, a bridge across a broken portion of the road; another pontoon company constructed a bridge 53 mètres in length with iron rails, and each of two other companies made a small bridge.

The pontoon companies reached Mukden on the 8th September.

Near Mukden there was only the railway bridge, and a bridge for carts. Twelve bridges were constructed over the Hun-ho, but space does not here admit of their description.

Considerations.—The need of bridges was much felt by the Russians. The fault did not lie with the pontoon companies, but with their organization, which was incomplete, and with those in high command, who did not always supply the bridging companies in time. The pontoon companies were, in fact, not permanently assigned to any large unit, but were attached to one or the other of the commands as needed for the time being, and this produced confusion and uncertainty.

A lamentable want of care was also shown in allotting troops for the protection of the bridges.

After the passage of the Xth Army Corps over the Tan-ho, and under the pressure of the Japanese advance, there was only a detachment of 90 riflemen for the bridge of Kindiatunsigu, and these same men had later on to protect also the bridge of Siotuntsi.

March, 1908.

TRIALS OF PORTABLE SAPPER TOOLS IN FRANCE.—*La France Militaire* (No. 7,078 and 7,082) is informed that the French Minister of War has given orders for trials to be made by some of the troops with new sapper tools. One of these is the invention of Colonel Bruzon, of the 24th Infantry, and is called *bêche-Bruzon;* the other is the invention of Commandant Seurre (chief of the central depôt for engineer war material), and is called *pelle-pioche.*

The following descriptions of these tools are given.

The Bruzon spade consists of a blade, a handle, and a case. The blade, which is shaped like a halberd, consists of a trapezoid prolonged with a triangular part and has sharpened edges. The trapezoidal part is slightly curved to allow the excavated earth to be easily gathered up. The handle is of ash; the case is of brown leather with a fastening for attachment to the belt.

The tool with its handle weighs 825 grammes; the case weighs 175 grammes, the whole weight being 1 kilogramme. It is usually carried suspended from the belt, rather far back on the right side. However, during rapid movements in the field it may be temporarily suspended between the third and fourth button of the great coat.

The Bruzon spade may be used (1) as a spade, holding it like a dagger and digging into the earth; (2) as a shovel; (3) as a billhook; (4) as a pickaxe for cutting loopholes in walls; (5) occasionally as a

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hatchet for opening loopholes in a wooden palisade. The instrument may also serve to cut iron wire, and, placed on its point on the ground, may act for a rest for the rifle when firing from the lying-down position.

The *Seurre spade-pick* consists of a blade, a handle, and a case. The blade is a special combination of a portable spade, and of the pick now in use. It is formed by substituting for the pick a flattened blade with another having the form of a spade; the point is retained with slight modifications in the dimensions. The two edges of the spade serve, one for cutting wood, and the other—less sharpened—for hard material.

The handle is like that of the pick, only somewhat shorter. The case, of brown leather, is like that now in use.

The spade-pick may be used (1) as a tool for digging, and can be used either as a spade, shovel, or pick; (2) as a billhook, using the sharpened edge; (3) as a pick for opening loopholes in walls; (4) as an axe for cutting loopholes in wooden stockades. It can also be used to cut iron wire and as a rest for the rifle when firing from the lying-down position.

GERMANY.

ON THE EMPLOYMENT OF AUTOMOBILE CARRIAGES.—The military journals are informed that an allotment of 1,800,000 marks has been agreed to by the Reichstag for the purchase of automobile carriages.

At the end of last year the sum of 700,000 marks was allotted for the purpose, and the increase in the current year shows that the German Army propose to make great use of automobiles in the event of war.

It now appears that these allotments are not only destined to increase the automobiles for the army, but also to provide on the frontiers a large number of automobiles, which could be placed at the disposal of the local authorities and used by them in peace time, on condition that they be at the disposal of the military authorities on a declaration of war.

The intention to use automobiles extensively in war time may also be deduced from the Cabinet Order of 27th January, 1908, which appoints 52 officers of the reserve as automobilists (Kraftfahrtruppen). These officers are given the rank of lieutenant, and are charged with the duty of seeing that the automobile carriages are kept in a good state and in proper working order.

EXERCISES FOR TRANSPORT WITH AUTOMOBILES FOR HEAVY CARRIAGES.—It is understood from the *Neue Militärische Blätter* that the drill season of the "communication" troops will very soon comprise a journey of two weeks in the Hartz district with the following types of carriages:—(1) Vehicles of the Daimler type for heavy loads. These are stated to have given good results in the trials of 1907 during the manœuvres at the fortress of Posen; (2) an omnibus of the Bussing-Braunschweig type, and a train, Siemens-Schuckert, of five carriages in tow; (3) a steam locomotive, Fowler, with two carriages in tow. There will also be other automobiles for the transport of men.

The itinerary will be *viâ* Berlin, Magdeberg, Halberstadt, and

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Quelinberg. On arrival at the Hartz the vehicles will run on several roads.

Under an order of 23rd January, 1908, the War Minister has decreed that all wagons and carriages for service with troops for the detachments of mitrailleuses, and for the pioneers of the troops of communication and trains (including those for sanitary purposes), shall be painted grey-green, called "feld-grau."

The discussion on the military balances in the Reichstag resulted in an allotment of one million marks for the purchase of kitchens on wheels. Their utility was shown in the Russian-Japanese War, and this was further proved by the models which were experimented with at the last Imperial manœuvres.

REGULATIONS FOR THE CONSTRUCTION AND REPAIRS OF MILITARY HOSPITALS IN FRANCE.—Pasetti.—*Programme for a District Military Hospital.*—According to the regulations of 7th July, 1877, each army corps should have in the district that it occupies—and if possible at the headquarters of that district—a military hospital for the cure of the sick, for special instruction, and for the preparation and maintenance of sanitary material required by an army corps in case of mobilization. The capacity of these hospitals is not fixed; it will depend upon the strength of the garrison and on the sickness in each district, calculated on the average of the last 10 years. In order to fix precisely the programme to be adopted for the organization and construction of these buildings, it is supposed that the district hospital should contain 300 beds.

Site.—The area of the site should be about 200 square mètres per patient, equivalent for a hospital of 300 beds to an area of 6 hectares, or 14·8 acres.

General Disposition of the Wards.—A hospital of 300 beds should consist of two wards for ordinary diseases, two wards for injured patients, and one ward for contagious diseases. The last should be completely isolated from the rest of the hospital.

The barracks for the hospital attendants, the laundry, disinfecting rooms, mortuary, laboratory, etc., should be within the hospital enclosure. An enclosure wall should surround the whole.

The vacant spaces of the enclosure should be laid out as gardens and walks, and arranged so as to allot a section to each category of the sick (common diseases, injured patients, and the several contagious groups).

Special Arrangements.—The wards should be arranged parallel to one another so as to ensure the best orientation. In the central districts of France the wards should face east and west. The wards should be comprised in a ground floor and a first floor. Each ward should contain from 50 to 60 beds, divided between the ground and the first floors. The common rooms should not have more than six beds; the space between the beds should not be more than 1·50 mètres. The dimensions of the rooms should be calculated on the basis of 10 square mètres per bed and 40 cubic mètres per patient.

Common Wards for the Sick.—The auxiliary rooms should be grouped at the centre of the wards and—both on the ground and first floors—should

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consist of the following:—A refectory, a room for conversation, a small room for letters and correspondence, a dispensary, gas furnaces for heating plates, a lavatory, a waiting-room, water closets.

Wards for Injured Patients.—One of these wards should be assigned for injured patients; the other for cutaneous diseases, etc. The two groups should be completely separated, and each should consist of an operating room, a room for the instruments and apparatus, and places for undressing and washing. In each of the operating rooms there should be special arrangements for heating.

Wards for Contagious Diseases.—A hospital for an army corps does not usually receive a large number of sick affected with contagious disease, because there are other hospitals to which such patients may be sent.

Administrative Wards.—These should be on the ground floor. The first floor should be reserved for officers and non-commissioned officers.

A separate building of one story only should be erected for the following services:—Bacteriology, hydropathy, ophthalmia, dentistry, etc. This building should be united to the sick ward by a covered gallery.

Infirmary Barracks.—These should be provided on the ratio of one convalescent to five patients. On the ground floor there should be rooms for N.C.O.'s, a dining and sitting room for N.C.O.'s, a dispensary, a visiting room for the medical officer, a room for the sick confined to the house, a hygienic closet, a refectory, a recreation room, a reading room, lavatories, water closets, and, lastly, two cells for men undergoing punishment. On the first floor: the common ward for 15 beds, lavatories, and water closets.

EDWARD T. THACKERAY.

VOËNNYI SBÓRNIK.

February, 1908.

REMINISCENCES OF THE SIEGE OF PORT ARTHUR.—This article contains some information on hand grenades. In the arsenals at Port Arthur many old Chinese shells were found; these were filled with black powder, and the end of a piece of Bickford's fuze was inserted, the remainder of it projecting 2 to 2½ inches. Such grenades weighed from 6 to 7 lbs. each, and were therefore too heavy to throw far. Tins filled with pyroxiline, weighing 2 to 2½ lbs. each, were also used as grenades. Another most useful grenade was made from the empty cartridge case of the 47-millimètre gun filled with pyroxiline. Some of the Japanese grenades were made of bits of bamboo filled with melinite.

The heavier type of grenade could not be thrown more than 20 paces, and was only used because the supply of pyroxiline was limited. Other explosives such as "rackarock" and "samson" were used instead, but were more dangerous to handle. Sometimes as many as 1,500 grenades

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a day were used by the Russians; at close quarters the men preferred them to their rifles.

A hand grenade, to be thoroughly satisfactory, should, apart from its explosive qualities, satisfy three conditions :—

(1). It should be safe to handle.
(2). It should not weigh more than from 2 to 2½ lbs.
(3). It should be easily and simply ignited.

The Japanese melinite bombs only satisfied the second condition; when struck by bullets they were ignited and then exploded; Japanese men carrying grenades were frequently blown to pieces.

A supplement in connection with the trial of Generals Stoessel, Folk, and Reuss contains the minutes of six councils of war held in Port Arthur. In one of them questions arising from the defective state of the fortifications were discussed and the conclusions arrived at were shortly as follows :—

I. At the outbreak of hostilities a small portion only of the fortifications was finished, those on the sea front being in a more advanced state than the remainder. This necessitated the construction of temporary fieldworks to take the place of permanent works, some of which were not even started.

II. The forts were too near the harbour and town, and did not prevent them being bombarded by field guns.

III. The fortress was exposed to fire both from land and sea, only a small part of the sea front being defended by coast batteries.

IV. The high ground in front of the fortress allowed the enemy to manœuvre and plant his batteries without being seen.

V. The source of water supply was in front of the line of forts, and was only protected by fieldworks, constructed after the outbreak of war.

VI. Owing to the configuration of the ground the forts were laid out in one line; the whole defensive front was too thin and could be easily pierced.

VII. All the guns in the forts on the land front were exposed.

VIII. At the beginning of the war the batteries on the land front were not armed.

IX. The defence of the ditches was weak, and adapted exclusively to rifle fire.

X. The majority of the forts were badly sited, having no field of fire at close ranges.

XI. The number of guns allotted to the fortress was inadequate, and the guns themselves were not of modern pattern. About 110 guns were taken from the fleet and mounted. The supply of ammunition was insufficient.

XII. There was no balloon equipment.

XIII. There was no fortress railway.

XIV. No telephonic communication between the forts existed before the war began. Aerial lines were subsequently put up, but were frequently cut.

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XV. The length of land front was 21 versts and of sea front 8½ versts; a force of two divisions was quite inadequate for the defence of this perimeter. The general reserve was far too small. (A verst = 3,500 feet).

March, 1908.

REMINISCENCES OF THE SIEGE OF PORT ARTHUR (*continued*).—Hand grenades could not always be thrown far enough to reach the Japanese saps, which were moreover usually laid out in such a way as to be out of view of the artillery. It occurred to the writer, a naval officer (Lieut. N. Podgyrsky), that light torpedoes might be employed with some effect.

The type of torpedo used has no motive power of its own, but is fired from a tube by a charge of powder. It has a striker at its fore end, with a percussion apparatus for exploding the charge, which is in a chamber immediately behind and consists of 77 lbs. of pyroxiline. The after half of the torpedo is hollow to give buoyancy, whilst at the tail end there are fins which have to be set when the torpedo is aimed; it is 7½ feet long, has a greatest diameter of 10 inches, and weighs 180 lbs. in all. With a charge of powder about one-third bigger than that used at sea these torpedoes could be thrown to a distance of about 70 paces. Seven tubes were mounted at different positions and did good service.

A. H. BELL.

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CORRESPONDENCE.

COAST EROSION AND ITS PREVENTION.

DEAR SIR,

Since the publication of my Paper on the above subject in the *R.E. Journal* for the month of June, I have learnt that the map which accompanied it, illustrating the "Development of Dungeness Point," was compiled by Colonel S. A. E. Hickson, D.S.O. My acknowledgments are therefore due to him for the use of it. The map in question embodies the results of a great deal of research and is a very valuable record. Colonel Hickson modestly refrained from putting his name on the drawing, and I was quite unaware that he was the author of it.

WM. PITT,
Colonel.

The Editor, *R.E. Journal.*

DUST PREVENTION ON ROADS.

DEAR SIR,

The following notes on an experiment with calcium chloride as a dust preventer are extracted from the *Engineering Record*, and may possibly be considered of sufficient interest for reproduction in the *R.E. Journal.*

The roadway, on which the experiment was carried out, is situated in the Agricultural Department grounds in Washington, B.C., and is built of Trap rock, held in position by a soft limestone binder.

In preparation for the treatment, all dust and dirt were scraped away from the surface of the road. A solution was prepared by thoroughly mixing 300 lbs. of commercial calcium chloride (granular containing 75 per cent. of calcium chloride and 25 per cent. moisture) with 300 gallons of water in an ordinary street sprinkler. It was then applied to the road, the sprinkler passing slowly to and fro to facilitate complete absorption of the solution. Each application consists of 600 gallons over an area of 1,582 square yards, or ·38 gallons per square yard. After the surface was once thoroughly saturated no watering was required for some time. The solution affects the appearance of the road, which varies in colour from a light grey when dry to a greyish brown when moist. The texture of the road surface was completely changed. Before treatment the whole surface appeared loosely knit together, but after treatment the surface became smooth, compact, and resilient. The total cost for two applications, ranging over a period of about three months, worked out at about 1d. per yard super.

No mention is made of the nature of the mud formed in wet weather, or whether the road surface becomes more than ordinarily slippery.

The experiment proved that as a dust preventer the solution of calcium chloride was more effective and lasting than water, and acted in a slight degree as a preservative of the road surface.

R. N. HARVEY,
Major, R.E.

The Editor, *R.E. Journal.*

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,, P. S. Allen, Gordon Highlanders.
,, J. K. Cochrane, Leinster Regt.
,, R. L. Ricketts, Indian Army.
,, W. K. Bourne, Indian Army.
,, F. W. Lumsden, R.M.A.

The following Officers received nominations:—

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Capt. C. J. C. Grant, Coldstream Guards.
Capt. W. D. Wright, V.C., Royal West Surrey Regt.
Capt. C. H. Harington, D.S.O., Liverpool Regt.
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Capt. and Bt. Major N. J. G. Cameron, Cameron Highlanders.
Capt. G. P. Grant, D.S.O., Indian Army.

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WOOLWICH, JUNE, 1906.

31st ... ... J. S. Barkworth 6,483

DECEMBER, 1905.

SECOND	H. G. MacGeorge 7,196	16th	R. Crofton 6,330
FOURTH	G. Walton 7,046	45th	D. Stephenson 5,899
FIFTH	H. A. Cox 6,967	54th	J. Kennedy 5,711

This was the First Examination under the new regulations, and our pupils secured THREE out of the first FIVE places.

MILITIA COMPETITIVE, MARCH, 1906.

A. E. Hardy	2,304	W. F. Anderson	1,947
N. H. Hutcheson	2,105	D. C. Robinson	1,879
F. D. Frost*	1,949	F. A. Bowring	1,876

*Read partly at the Army College, Aldershot.

ARMY QUALIFYING, 1906.

Nineteen passed.

Special Arrangements have been made for the Army Qualifying in next Examination.

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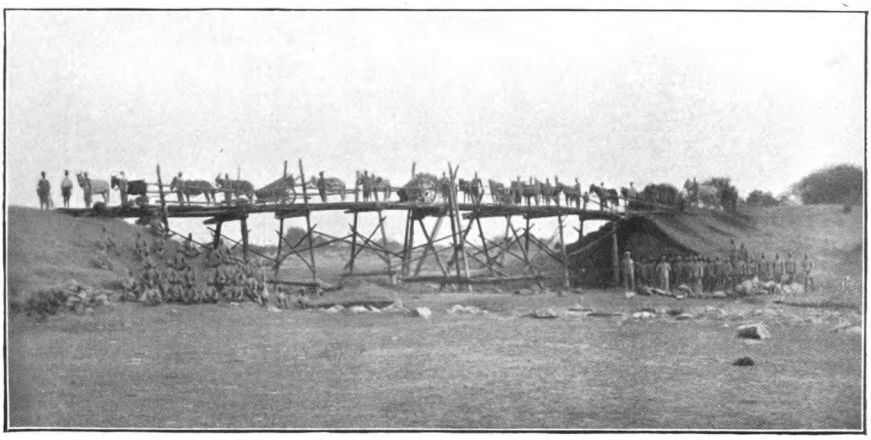
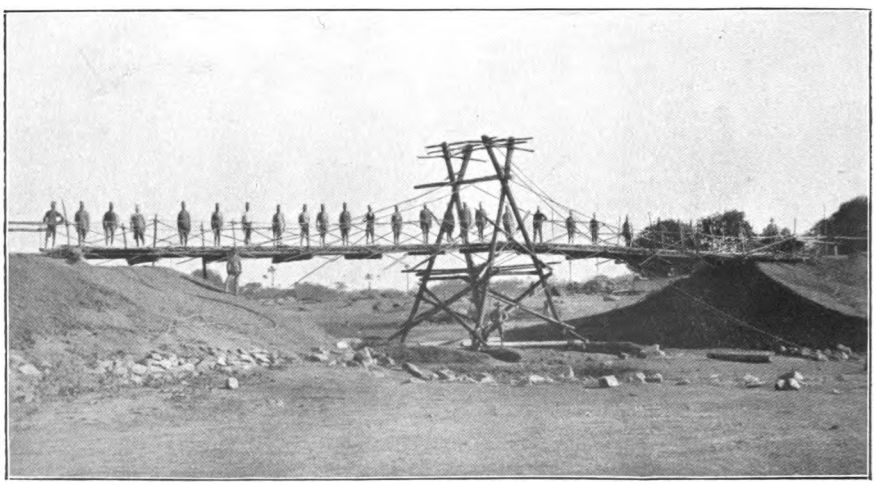
PALM TREES AS BRIDGING MATERIAL.



120-FOOT 15 FEET HIGH TRESTLE BRIDGE.

Some trestles and some bays of roadbearers from palm trunks.

10th Company, 2nd "Q.O." S. & M.



120-FOOT CENTRAL SUPPORT SUSPENSION BRIDGE.

Central support, 4 palm trunks.

10th Company, 2nd "Q.O." S. & M.

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SOME EXPERIMENTS WITH PALM TREES AS BRIDGING MATERIAL.

By BREVET MAJOR R. L. MCCLINTOCK, D.S.O., R.E.

ON first landing in Southern India a European cannot fail to be struck by the number of tall and slender palms, long and straight as the northern pine, which cover many parts of the country.

When he enquires as to their use, however, he is told by older residents that palms are no good as timber for building or bridging purposes. Reference to the *Manual* gives him no assistance, for although para. 20, Sec. II., of that work, puts him in possession of the Modulus of Rupture of some 50 varieties of timber—ranging from Singapore to Canada, or from Russia to Australia—it makes no mention at all of the palm.

The first and most obvious test of the quality of any unknown timber is to observe the use made of it by the natives. This fails in the present instance, as the palm family are far too valuable as food and drink producers to be felled for timber. So the enquirer is apt hastily to conclude from the fact that he does not see palm timber in local use, that it must necessarily be worthless—forgetting that neither do apple or pear trees figure extensively in the hands of European joiners. In the end he probably accepts without experiment the idea that palm trees are without value as timber, and in time transmits this delusion to his successors.

The above was the case with the writer, who for several years unquestioningly accepted this idea. A combination of circumstances however finally led him to experiment, and after devoting some months to the trial of palm spars in various forms of bridges, he arrived at the conclusion that the timber in question had hitherto been libelled in popular estimation, and that it was quite worthy of the attention of the military engineer.

This does not mean that a palm trunk is as desirable a spar for bridging purposes as one of Baltic fir, deodar, or teak ; but the art of the military bridge builder largely lies in making the best of the material which he finds on the spot, and in South India the palm is very conspicuously on the spot—in many parts to the exclusion of almost all else. In the Deccan, for instance, other timber suitable

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for spar bridges is far from abundant. There are plenty of trees, but most of them are either short and stunted, or else thick and distorted (like the boabab, etc.), and, even in the Nizam's Government forests at Warangal, it is most difficult to obtain suitable bridging spars of over 25 feet in length.

The whole country is however profusely studded with various varieties of palms, from 40 to 60 feet in height, devoid of branches, and normally as straight as a mast.

Among the palms of the Deccan there are three main varieties, and as they are much alike to the casual eye, it may be as well to detail them here :—

1. Palmyra palm (*Talgachh*). Also known as the "fan palm," as its leaves supply the common palm fans so often seen in England.

The timber of this tree appears to be the best of the palm family. Practically its sole economic use is as the producer of a juice which, when fermented, gives an intoxicating drink called "toddy," and is largely consumed by the natives of the Deccan. Owing to the methods of extracting this sap being quite different from those employed in the case of the kajoor palm (an incision being made in the cabbage-like top of the palm, instead of in the trunk itself), the palmyra does not appear to suffer structurally from this practice, although its rate of growth is somewhat diminished. Whether tapped or not, a palmyra palm finally reaches the height of 40 to 60 feet, which is said to represent an age of from 120 to 150 years according to soil.

2. The wild date palm (*Kajoor*).

This tree also is principally used for the provision of palm wine, and as it is periodically tapped by deep incisions being made on alternate sides of the stem, it is totally ruined as a spar, as it becomes stunted and grotesquely distorted. The very few trees, which are spared this tapping for the sake of their fruit, grow from 30 to 40 feet in height, but the wood appears somewhat softer than the palmyra, and not so suitable for use as spars.

3. The cocoanut palm (*Narial*).

This tree in appearance, foliage, etc., is somewhat similar to the wild date, and likewise attains a height of from 30 to 40 feet. It is not so plentiful in the Deccan proper as the palmyra and date palms, as it is more generally found within reach of the sea. Most of the palms, which grow in the inland Deccan, have been planted in private gardens, and on this account, as well as on account of their large value as nut and toddy producers, it is very difficult to get permission to cut one down. For this reason I have so far been unable to carry out enough experiments with this timber to be conclusive, but from what has been done—together with information gathered from native sources—I should say that it ranked between the palmyra and the date in point of quality.

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A curious feature of the palm family is that during its life a palm tree preserves a fairly constant diameter, being nearly as thick when 5 feet high as when 50. This thickness is usually about 9 inches, and is practically uniform all the way up. When quite young and only a few feet high, the tree consists of a hard outer case or rind some 2 inches thick, the remainder of the stem being filled with a soft, sappy and fibrous mass. As the tree grows older and taller, the hard shell thickens from the base upwards, till finally, when the tree is some 60 feet high, it will be practically solid for the lower 20 feet. The centre 20 feet will have a thick outer shell and a fairly dense and hard filling, whilst, in the top third, the thickness of the shell diminishes and the softness of the filling increases right up at the cabbage-like top of the tree, where it is of the same structure as when young. For this reason the top third of a palm tree should be eschewed as a spar. The centre portion does well enough for either trestle legs or road-bearers, whilst the bottom part—being dense and close grained (especially in the case of the palmyra)—will do for pretty well anything, and can even be sawn up into planks.

From the above description it will be seen that a palm-trunk is in structure like a pipe; the greatest strength is at the circumference, while the neutral axis is weak. Consequently when "tested to destruction" under a cross-breaking stress, it fails in the same way as a pipe—*i.e.*, by buckling—and not by splitting or snapping as would an ordinary spar.

Two photos are given to illustrate what can be done with palm spars as bridging material. Palmyras were used in both cases as being more easily obtainable than either of the other two kinds of palm.

The first photo is that of a heavy trestle bridge, 15 feet high, for infantry in fours, crowded or loaded carts. In this bridge on account of the expense some, though not all, of the trestles were made entirely from palm trunks. Several entire bays of road-bearers also (span 12 feet) were made from the same material.

This bridge was tested in excess of the full calculated load, and although three road-bearers—composed of palm trunks—were used in each bay, no symptoms of bending or buckling were observed. From this experiment it may be taken that palm timber is amply good enough for ordinary spar bridges.

The second photo is that of a central support suspension bridge for cavalry in file or loaded bullocks—span 120 feet.

In this case the four legs of the central support were made from four 30-foot palmyra trunks. As the total weight of roadway and load came to something like 21 tons, this was a pretty severe test, but the legs stood it successfully.

The use of a palm trunk as the transom over which the two cables pass on the top of the central support was also tried experimentally,

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but symptoms of buckling were observed, and a teak spar was finally substituted.

Finally a field observatory 100 feet in height was made by superimposing one 60-foot palmyra on the top of another still growing.

It may be interesting to note that in the above type of suspension bridge the shore struts shown in para. 208, *Manual*, III., do not appear to be necessary, as when one-half of the bridge is loaded and the other half empty, the bridge only deforms very slightly. In the present case, with 60 men on one half and nothing on the other, the cables ran over the central pier transom to the extent of half an inch only.

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TRESTLE BRIDGING.

By MAJOR J. C. MATHESON, R.E.

As a small supplement to Capt. Mozley's interesting article on trestle bridging in the May number of the *Journal*, it may possibly be of some use to mention another method of placing trestles in deep water, which was found successful at Chatham in 1898.

A tidal ramp was being constructed as part of a bridge across the Medway from the Dockyard to Upnor Hard. The large size of the trestles precluded launching in the usual way, and, owing to the strength of the current and the weight of the trestles, it was very necessary to get them into exact position as they were raised, since any movement afterwards was almost impossible. Each trestle had double legs, double diagonals, and three ledgers to prevent settlement in the mud. The legs of the largest were 33 feet long, so that the weight was considerable.

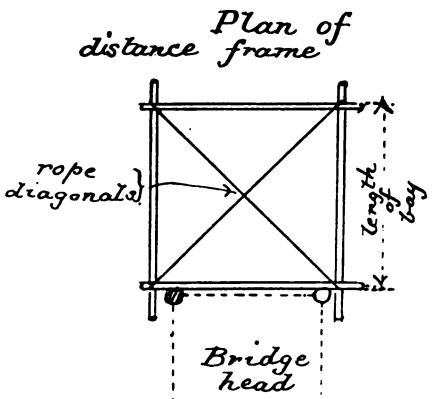

FIG. 1.

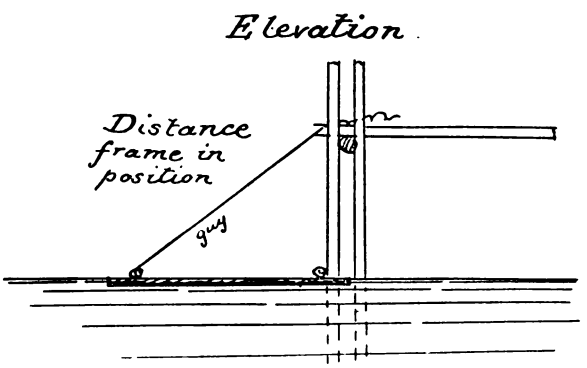

FIG. 2.

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The first trestle was launched from the Dockyard wall in the ordinary way. For the remainder, the following method was adopted. A distance frame was made of four spars with diagonals of rope and floated to the head of the bridge as shown in *Figs.* 1 and 2. The trestle was then floated and towed, or warped out, to the bridgehead, and placed as shown in *Fig.* 3, the tips pointing away from the bridgehead, and the bottom of the legs floating underneath the front of the distance frame. Head guys were attached and two sets of

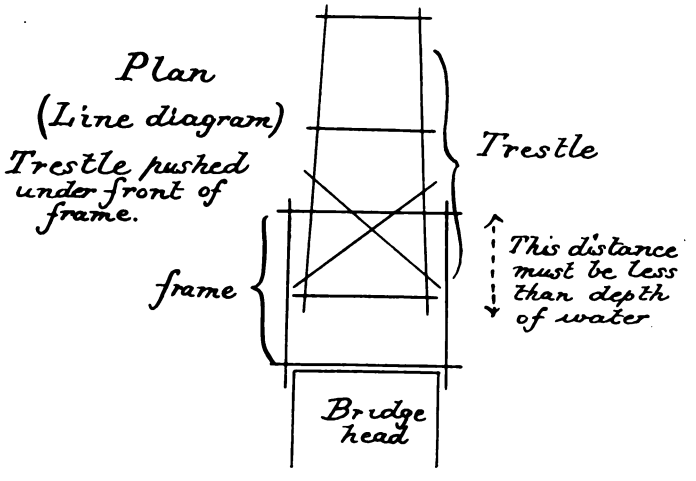

FIG. 3.

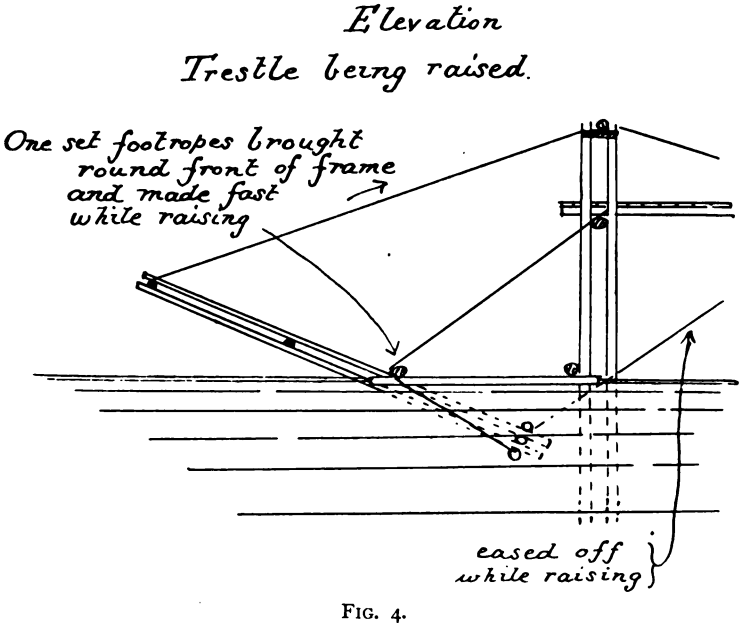
Elevation
Trestle being raised.
One set footropes brought round front of frame and made fast while raising
eased off while raising

FIG. 4.

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foot-ropes, one of which was brought up round the front spar of the frame on to the bridge. The trestle was then easily raised (*Fig.* 4) by hauling in the head guys and easing off the ordinary foot-ropes, the legs pivoting about the front spar of the distance frame. As the trestle became vertical, the extra set of foot-ropes was eased off and the legs took the bottom. No weighting of the feet was found necessary, which was an advantage. The distance frame ensured accurate position, the extra foot-ropes preventing it from rising when the head guys were hauled on.

Five trestles were placed in this manner without difficulty, except in the case of one which was raised when the tide was high and the depth of water about 18 feet or so. This trestle floated in a vertical position when raised, but it was kept vertical by the guys and foot-ropes, and was made to take the ground by getting the roadway out on to it.

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BRIDGE OVER THE KHARMANA AT SUDDA, KURRAM VALLEY.

By COLONEL G. K. SCOTT-MONCRIEFF, C.B., C.I.E., R.E.

THE Kharmana is a stream which rises in the Safed Koh Range south of Jalalabad in Afghanistan, and which with its affluents drains the upper reaches of the Afridi Valley of Tirah. It is a tributary of the Kurram, which again is a tributary of the Indus. The highest peaks in the watershed run up to 14,000 feet, the height of the river at the bridge site being 3,300 feet. The catchment area is nearly 180 square miles.

Our knowledge of this country is limited to the operations of the campaign of 1897, so it is not possible to say much about it except that snow melts on the upper reaches early in the year, but that the cultivated nature of the valleys and the wooded slopes of the hills have a certain restraining effect on floods.

The road is the main line of communication up the Kurram Valley from Thal to the foot of the British boundary at the Peiwar Kotal. As this stream is the largest which is crossed on the way, and as it is frequently in violent flood for several days, it is a matter of much military and commercial importance that communication should be unimpeded.

The question of providing a suspension bridge was first considered, but the idea was rejected, as this class of bridge is even under the best circumstances subject to oscillation. Steel girders calculated to give a 12-feet roadway were also considered, and it was found after working out the cost of various types that 40-feet girders would be the cheapest.

Orders were, however, given, about the time that the author took over charge of the works in the N.W. Frontier Province, to consider whether an arched masonry bridge might not be better than a girder bridge. It was found that a masonry bridge with 40-feet spans and 16-feet roadway could be built more cheaply than any steel girder form, and the comparative estimates having been submitted to the Government of India, the masonry form was, of course, accepted. The reason why this form gave a cheaper bridge than a steel girder is that there happened to be near the site an excellent quarry of mountain limestone, whereas if girders had been used, not only would they have to be brought by railway for a long distance, but the terminus of the railway is 34 miles distant by road.

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As regards other materials, limestone boulders in the bed of the stream were burnt for lime, and a bed of alluvial clay near the site gave very fair bricks and surkhi. At first it was feared that the bricks would be of little use, but after one or two trials, the quality improved so much that it was ultimately decided to use this material for the arches.

The stream flows in a fairly well-defined channel, and for some miles above the site there seems to be little variation in the bed. On either bank, near the bridge site, the country is cultivated in terraces; on the left bank there is a steep declivity, but on the right the country slopes gradually away from the river bed.

The longitudinal slope of the bed is about 1 in 50. The violence of floods has brought down boulders of great size. Taking the area of highest known flood section at 1,055 square feet with a wetted perimeter of 450 feet, and a value of the coefficient of roughness of 0·020, the calculated velocity is 18 feet a second, and the flood discharge 18,990 cubic feet per second. The bridge as designed could no doubt pass a greater flood than this, but inasmuch as the conditions of the rainfall and flood discharge were somewhat imperfectly known, it was considered advisable to adhere to the size given, rather than restrict it.

The question of the depth of the foundations was a matter or very careful consideration. The first proposal was to make these 10 feet deep. It was thought that the scour would then not be more than 6 feet. As a matter of fact, it proved during construction to be 8·5 feet, and as the floods did not reach nearly to the maximum as pointed out by the oldest inhabitants, the chances are that it will some day amount to 10 or 12 feet. However, this was not known at that time. The author proposed 13-feet foundations, basing his views on the behaviour of certain bridges which he had in former years built over somewhat similar streams. But subsequently this was increased to 14 feet.

As the bed of the stream was strewn with very large boulders, it appeared probable that little water would be found in the excavations. This was the case, and the water which was found was easily kept down with hand pumps.

The design of the arches, viz., 40-feet span with 10-feet rise was decided upon partly to raise the roadway on the left bank, and thus prevent too steep a fall from bank to bridge, and partly to allow room for floating matters brought down by the torrent. The springing of the arches was taken at 2 feet above the highest recorded flood.

The arches are arranged in three sets, so that there are two abutment piers. The reason of this was that during construction it was intended to let the stream flow through the centre set, while first one set of three arches at the left bank, and then the set of three arches

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of 40 feet and one of 25 feet at the right bank, were complete. All this time the ordinary flow of the stream would pass, as it usually does, through the centre, kept in place by training works. Then after both the end sets were complete the river could be trained to one or other, or both, of the completed parts, and the central portion could be finished.

The orders given were that centerings were to be left in position after the arch was finished, for at least a week. The reason of this order was that the author is convinced, both from theory and by careful experiment, that in every arch which is built on a circular arc there must be some joints where the line of resultant pressure falls outside the centre third, and where therefore inevitably some reliance must be placed on the tenacity of the mortar. To give the mortar some chance of setting, a week was the least time ordered, and it is remarkable that in those cases where more than a week was given there was absolutely no observed settlement whatever. In those arches which had been up for a week there was a slight observed settlement, under one inch in every case.

Before quitting the subject of the arches it may be mentioned that they were built of ordinary bricks, and two sorts of special taper bricks, as introduced by Mr. C. Richardson on the Severn Tunnel. The taper bricks were stamped I. and II. respectively, the former being nearest the soffit. Each of these bricks had exactly the same cubic content as an ordinary brick, and it was, therefore, equally easy to handle. Not only is bond given to the arch ring by this means both longitudinally and transversely, not only is cutting and rubbing of the surface of the bricks avoided, but the work is even cheaper than ordinary brickwork, for the bricklayers can lay the bricks without troubling themselves much as to keeping bond, putting in closers, etc.

It had, indeed, been intended to use concrete arches, but the idea was abandoned for several reasons, viz., the difficulty of satisfactory ramming on wooden centering, the somewhat uncertain nature of the material, and the relatively longer time that would be required in the concrete arch before the centering could be removed, and the ever present chance of a flood coming and carrying off the centering. The material for the matrix being only stone lime and surkhi (or crushed brick), it was necessary to make a series of experiments on the tenacity and adhesion, and although these experiments, which were at first unsatisfactory, gave subsequent results which would have justified the use of concrete in the arches, yet the other difficulties were so definite that it was ultimately decided to use brick, after it was found that the latter could be made locally of good quality.

The experiments showed that the most satisfactory concrete was obtained when the proportions were 1 lime, 2 surkhi, and 6 stone,

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broken to 1½-inch gauge and rammed. To show how weak even the best of such mortar is as compared with cement, it may be mentioned that the best results gave only 18·2 lbs. per square inch *adhesion* after a month, and 50 lbs. tensile strength in six weeks. The means of testing, however, was very rough, only good enough to point to the best relative proportions. A very large number of experiments were made.

In connection with the design it was resolved to continue the cutwaters of the abutment piers up to and slightly beyond the level of the remainder of the parapet. This not only broke the monotony of the long wall of the parapet, but it afforded a convenient recess where pedestrians could wait while a stream of traffic—such as a long train of laden camels, or a regiment on the march—happened to be coming the other way. The advantage of some such waiting place is well known to any who have travelled in the East.

The only other features in the design of any architectural interest were the corbelling of the parapets, which was not only economical, but introduced a pleasing break in the surface of the wall above the arch, and the design of the parapet terminals, which was arranged so as to be as simple as possible. It is true that some most handsome examples of bridge architecture might have been borrowed from bridges on the N.W. Frontier Road, between Kohat, Bannu, and Dera Ismail Khan, but these depended very largely on finely finished ashlar, and it was hardly possible to do much of that work in so remote a spot as the Kurram Valley. At the same time the author regrets now that he did not attempt a little more in this respect, with the example of the other bridges before him. Even a string course at the springing of the arches would have improved the appearance.

The lower part of the foundations in the piers was built in lime concrete (1 lime, 2 surkhi, 6 stone), the same proportions being used in the spandrils of the arches.

Work was not actually begun on the bridge till February, 1903, although it was sanctioned in October, 1902, as it was found difficult to get a respectable contractor to take up the work in so remote a spot. The local people, though the bridge was close to a large village, and was very obviously for their advantage, not only produced no supply of labour or animals, but were a source of continual trouble owing to petty thefts. Petty contract work, which at first seemed the most promising method of carrying out the work, proved unreliable. A contractor, however, at last was found, who took up the work at very remunerative rates. As, however, the actual cost of the bridge (Rs.64,000) was Rs.8,000 less than the estimate, and only amounted to Rs.144 (say £10) per running foot, the cost cannot be said to be extravagant.

The floods, which gave so much trouble at other works on the

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frontier in the spring of 1903, frequently retarded progress on this work also. Fortunately the foundation work in the central group of piers had been satisfactorily done in a comparatively dry period, so that the floods passed through the central group of arches while the outer sets of arches were being made. Several times the training works were outflanked, and the centerings threatened, but there was no actual loss of any, and although it happened more than once that the flood water bore down on absolutely fresh masonry, the mortar behaved very well, and there was hardly any loss.

The ends of the centerings rested on projecting stones built into the piers. These were afterwards cut off. The ribs were 5 ft. 6 ins. apart.

Scarcity of labour was an ever-present difficulty. All skilled labour, and to a great extent all unskilled labour also, had to be imported. The prevalence of cholera, and the difficulty of getting supplies, caused men to desert frequently, while many of them became nervous about attacks at night from the marauding tribesmen of the frontier. On this score there was, however, nothing to fear, for the camp in which the workpeople lived was surrounded by a wall and strong wire entanglement, and it had a strong armed guard on it at all times.

It was realized, too, that mischievous tribesmen from across the adjacent border might easily tamper with the sand boxes under the centering ribs, and thereby destroy the arches. This was guarded against by keeping armed watchmen on the works at night, with orders to alarm the guard in case of any such attempt being made.

The work was, however, completed without accident in eight months. It was open for traffic in September, 1903.

Capt. A. R. Winsloe, D.S.O., R.E., was in charge of the works during the whole of the construction.

The estimated cost was Rs.72,000, and the actual cost Rs.64,000.

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STUDIES ON THE USE OF FIELD TELEGRAPHS IN SOUTH AFRICA.

By MAJOR E. G. GODFREY-FAUSSETT, R.E.

II.—TELEGRAPHS AT COLESBERG.

A SECTION MAINTAINING THE INTERNAL COMMUNICATION OF A MIXED DIVISION.

AT the end of November, 1899, the headquarters of the 1st Telegraph Division was still camped at dusty De Aar. Of the four sections, Moir's (No. 3) was advancing with Lord Methuen on Kimberley, Henrici's (No. 2) was backing him up, and Jelf's (No. 1) and Mackworth's (No. 4) were awaiting orders.

Orders for a section to join General French's force at Naauwpoort arrived late on the 28th, and by 7.30 a.m. on the 29th No. 4 was on the train. A section of those days was of a composition differing considerably from what one is accustomed to in England—the marching-out strength was as follows :—

1 officer (2nd Lieut. Mackworth).
33 N.C.O.'s and men.
14 Cape boys.
11 ponies (riding).
39 mules.
24 oxen.
3 air-line wagons.
1 cable cart.
1 G.S. wagon.
1 Scotch cart.

It carried 15 miles of air line and 8 of cable, as well as some spare, and was then—as it is hoped it will always be—self-contained and independent.

A wearisome wait for a train at De Aar—a four hours' journey—another wait for an empty siding—and they were in camp at Naauwpoort.

General French, with a gradually accumulating force, was then at Naauwport, guarding the important railway junction, and reconnoitring towards Arundel and Colesberg. For the next week or two these "worrying" tactics went on, the telegraph section acting with them, sometimes with a cable cart, sometimes by tapping the railway telegraph line which ran northwards through Arundel to Colesberg.

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On December 7th Arundel was occupied, the Boers holding a position across the line at Taaiboschlaagte. The bad news of Stormberg, Magersfontein, and Colenso tended to impose caution in advancing, and to increase the confidence of Schoeman, who commanded the Boer troops, so that it was not until December 29th that the incessant skirmishing led to the retreat of the Boers to a position covering Colesberg.

The position of the enemy was a very strong one, on the line of the Schietberg and across the railway, and General French, after a reconnaissance on the 30th, could do no more than occupy Porter's Hill with cavalry and guns, at the same time bringing up his headquarters from Arundel to Rensburg.

The section now maintained and worked the railway telegraph wire from Rensburg to Naauwpoort as part of the L. of C. At Naauwpoort the work was handed over to the Cape Colony Telegraph Service.

On December 31st an offensive movement against the enemy's right resulted, early next morning, in the capture of McCracken's Hill, which was held as an advanced post throughout the operations. Cable was run from Rensburg to Porter's Hill, to connect up the post there.

Attack and counter-attack went on all through the 1st January, and by the evening the British were well established from Kloof Camp and McCracken's Hill on the N.W. to Jasfontein on the east, with a supporting post at Maeder's Farm, and headquarters at Rensburg.

The 2nd and 3rd of January passed without any serious fighting, and advantage was taken of the pause to extend the telegraphic communications. The Porter's Hill cable was carried on to Maeder's Farm on the 3rd, and an office opened there, and an extension was made in the evening to Coles Kop, a conical hill which dominates all the country, offices being opened at its foot and on its top. This was a heavy day's work for one cable cart, but it was fortunately achieved in time to be of great importance, as early in the morning on the 4th the Boers made a strong attack on the extreme British left at Kloof. The detachment of the Suffolks there was outflanked, and was in serious danger for a time, but General French, who at this moment reached Porter's Hill, was able to telegraph to Maeder's Hill for the troops there to advance. The Boers were driven back with a loss of about 130.

On the 5th the line was extended by bare wire on the ground from Maeder's Farm to Kloof, the cable having all been used up.

Reinforcements had arrived, and on the evening of the 5th an unsuccessful attack was made on Suffolk Hill, in front of Kloof, resulting in a loss of 11 officers and 150 men of the Suffolk Regiment.

On the 7th a reconnaissance to the right had shown a good posi-

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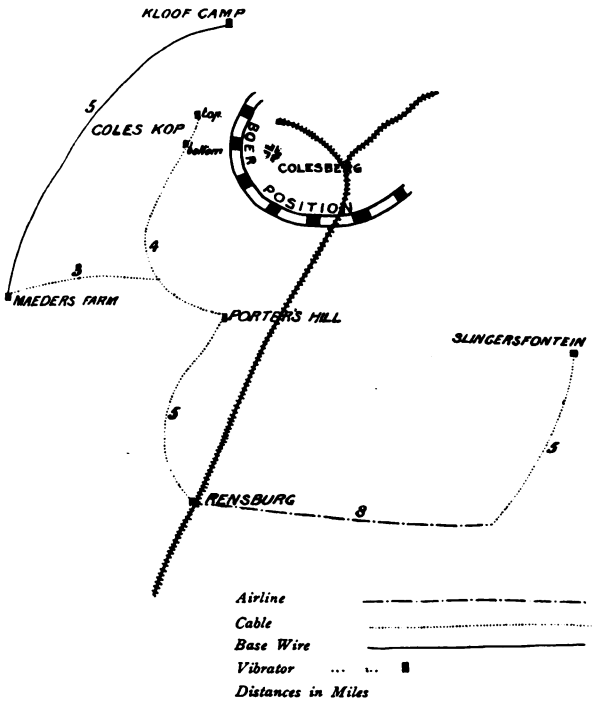
tion at Slingersfontein Farm, and this was occupied on the 9th by cavalry and guns under General Porter. A cable cart accompanied this force, laying 13½ miles, and leaving an office at Slingersfontein. During this march General French, who was with the column, was in direct communication through 20 miles of cable with the C.R.A. who was on Coles Kop, and was thus able to issue instructions as to artillery fire to distract the enemy's attention.



CIRCUITS, 11th JANUARY.

Next day some of this cable was replaced by air line, the party laying six miles in four hours, though the ground was dry and stony, and Mackworth took more cable out to Slingersfontein, ready for a reconnaissance on the 11th. The Boers, however, were in too great strength on this flank for our lines to be pushed further on.

On the 11th also a 15-pr. gun was placed on Coles Kop by the 4th Battery, R.F.A.—a great feat, as the height commanded the whole of the Boer position. This peculiar kopje is almost a sugar-loaf, with sides nearly precipitous, and is difficult to climb even with both hands free. A wire rope was slung by the field troop to enable supplies and ammunition to be hoisted. This gun—assisted by a second one a few days later—fired straight into several of the Boer laagers, to their immense astonishment.

The next few days were devoted to replacing cable by air line. Three more miles were done on the Slingersfontein line, and air line

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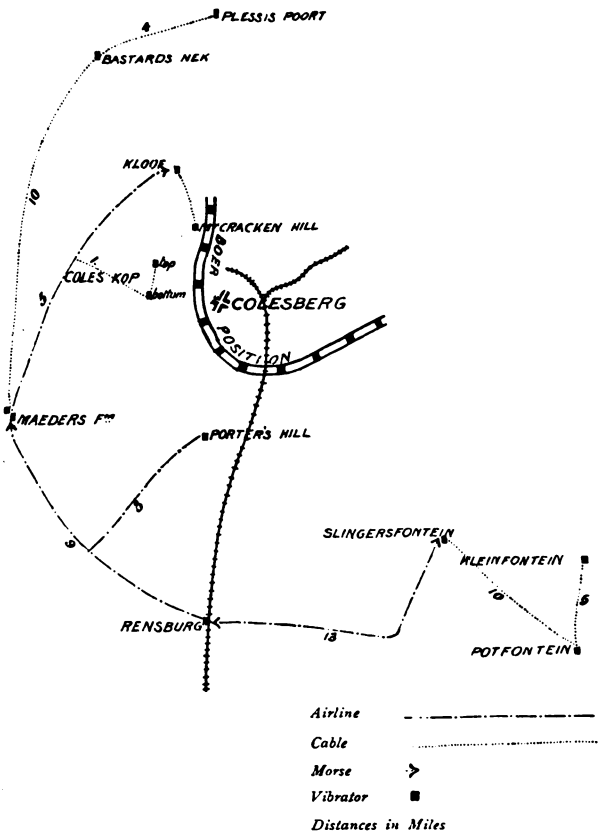
was run to Maeder's Farm and Porter's Hill. Morse was substituted for buzzer at Kloof, and cable was laid to McCracken's Hill.

An attempt to destroy the railway line at Achtertang by Major Hunter-Weston very nearly succeeded, and a serious attack by the enemy on Slingersfontein was beaten off. On the 15th and 21st strong reinforcements joined under Major-General Clements, including two howitzers which shelled Grassy Hill on the 19th, their fire being directed by telegraph from an observing station on the top of Coles Kop. The cable on the right was pushed on to Potfontein and Kleinfontein.

On the 20th Mackworth wired for more cable, and the O.C. brought him down the cable detachment of No. 2 Section, which was not in use elsewhere as No. 2 was engaged in maintenance duties at Orange River. The detachment which had arrived from England under Capt. Fowler took over the permanent lines up to Rensburg, thus freeing men and *matériel* for fieldwork.

The cable from Porter's Hill to Coles Kop was still lying out, though not in use. This was reeled up by night on the 23rd—24th, the



CIRCUITS, 24th JANUARY.

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experience being a rather exciting one, as it entailed approaching the sentries at Porter's Hill from the enemy's direction. An advanced guard was detailed, who whistled popular airs as loudly as possible when nearing the outpost line !

On the 24th Bastard's Nek was occupied, and on the 25th a strong column, accompanied by a cable cart, worked round towards Plessis Poort. In spite, however, of simultaneous attacks at Porter's Hill, and on the extreme right at Keerom Farm, nothing but information was gained.

At this point in the operations, Lord Roberts' advance on Bloemfontein entailed the removal of the cavalry and the bulk of the telegraphs. General Clements was left in charge at Rensburg, and a small telegraph detachment remained to maintain and work such lines as were still required.

The operations round Colesberg are of especial interest, as it was one of the few occasions during the war, when the Army Telegraphs were in sufficient local strength to undertake internal as opposed to external communications. That the tactical work was valuable, was shown by General French's statement that he would have been unable to hold his extended position without the telegraph lines.

The force was a mixed one, but at the close it amounted to seven battalions of infantry besides the equivalent of about six regiments of cavalry. This amounts practically to a division, and under the present telegraph organization it is probable that the following would have been available :—

Divisional	Cable Company	...	3 cable detachments.
Section	„ „	...	2 „ „
„	Air-Line Company	...	2 air-line detachments.

Whereas all that were present were two cable and two air-line detachments.

This greater strength would have enabled the work to have been carried out more quickly, and at several points simultaneously, cable carts actually accompanying the several advances, instead of lines being run to posts the next day.

In addition there would have been two or three infantry mule telephone detachments, which would probably have been used for outpost work.

The fact that headquarters were not moved after arrival at Rensburg, simplified matters immensely ; an advance when all the lines were out would have been a hopeless matter to deal with satisfactorily with so small a unit.

Similar cases of a comparatively small force actively engaged along a long line will doubtless occur in future campaigns, and a large percentage of telegraph troops will prove most economical on such occasions.

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ECONOMIC PRINCIPLES IN FACTORY DESIGN.

By MAJOR H. F. THUILLIER, R.E.

A FACTORY may be said to be any establishment where raw, or partially wrought, materials are converted into manufactured articles. Among the descriptions of factory which an engineer may be, and sometimes is, called on to design and construct are the following:—Single workshops; or large establishments for the manufacture of ordnance stores of all descriptions, such as guns, gun carriages, rifles, ammunition, harness, and saddlery; or arsenal stores. In wartime he may be required to construct, organize, and administer workshops for the building and repair of railway rolling stock; or establishments where structural steel work, bridge girders, etc., are manufactured. Large slaughter yards and bakeries—such as those at Aldershot—come also under the head of factories. Even the arrangements for mixing mortar and concrete and delivering them to the places where required, and the organization generally of large construction works, should follow in their inception the general principles set forth in this article.

In designing any engineering work the first end to be kept in view is to adapt it as completely as possible to the purpose for which it is intended. To this end regard must be had to the economic principles which govern the processes of manufacture of the articles to be produced at the factory.

Although these processes and methods may differ widely in the case of different manufactures, it is nevertheless true that whether it is steel that is being converted into girders; timber, iron, and brass into carriages; raw hides into saddles and boots; or live oxen and sheep into beef and mutton, the same broad principles govern the organization of the system of manufacture.

It is of the first importance that these principles be most carefully borne in mind in the design and siting of the buildings and other works which make up the factory establishment, and of the means of transporting, handling, and converting the materials. If they have been insufficiently attended to, the inevitable result will follow that the output cost of the finished product will be greater than it need be, and the difference in this respect between the produce of works scientifically arranged and organized, and of those which either from avoidable or unavoidable causes are not so, will be very considerable.

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The following are the main items which make up the output cost of manufactured articles :—

(1). The cost of the material, including delivery at the site of the factory.
(2). The cost of the manual labour employed in converting it into the finished products.
(3). The cost of the mechanical power employed in the same process.
(4). The cost of packing, loading, and delivery to the consumers.
(5). The standing charges of the establishment.
(6). Repairs and depreciation of the buildings and plant.
(7). Interest on the capital expended in purchase of land, erection of buildings, and provision of plant.

Of these the last would, in the case of a private business, represent the shareholders' dividends. It is easy to see that if Nos. (1) to (6) cost more than they need, the dividends will be reduced or may vanish altogether ; since the prices obtained for the output depend on the ruling market rates. Although in the case of Government factories the obtaining of dividends has not to be considered, yet item No. (7) must not on that account be disregarded. To ensure economic administration it is of great advantage to keep a capital and revenue account for manufacturing establishments, but even if this be not done it should be borne in mind that the taxpayers, who provide the funds, stand in the same position to the factory as shareholders, and a national manufacturing institution cannot be said to be established on a sound financial basis unless, when the interest on the capital outlay has been added to the manufacture charges, the total cost of the outturn is no greater than it would be if purchased in the open market.

We may now examine how the design of the establishment will affect each of the above subheads of the cost of the outturn. No. (1) is largely dependent on the situation of the factory, which affects the freights on the raw materials. The situation of the factory is generally decided for the designer by superior authority, and often on administrative or strategic grounds, rather than on economic considerations. The latter however are so largely affected by the situation, that it is worth while briefly to glance at this aspect of the question.

Firstly, as already mentioned, it is desirable to locate the factory near the sources of supply of the raw material. Similarly, by locating it near the source of fuel supply, item (3) obtains an advantage. By placing it near the consumers of the finished product, item (4) is reduced. The above are seldom compatible with each other, for the raw materials will usually not be found near the places where the products will be consumed. Moreover army stores have to be issued to all directions of the compass and perhaps to all parts of the world,

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so proximity to raw materials may in such cases offer the best advantage. A situation at an important railway junction giving several lines of direct communication to the points of consumption is desirable, and in countries where more than one gauge prevails (as in India), it is important to avoid a situation which will entail a break of gauge in the transit either of the raw materials, or of the products. If the stores are for use abroad easy access to a port of shipment is necessary, and if the factory can be on a navigable waterway, so that the goods can be loaded direct into the ships, a marked economy would ensue.

The prevailing rates for labour, and the presence or absence of an artizan population, may make a considerable difference to item (2). This is a consideration that is sometimes overlooked. If a factory is established in a thinly populated or a purely agricultural district, skilled labour, and possibly unskilled labour also, will have to be imported, and imported labour always costs more than that which is indigenous to the locality. Also dwellings will have to be erected for the operatives, with the result of adding to the capital cost and increasing item (7). On the other hand, in towns land is expensive, and this might partially or wholly counterbalance the extra cost of an establishment in the country. Cheapness or dearness of building rates will also diminish or increase the capital cost.

Item (5), standing charges, may also be affected by the situation in respect of the cost of water and of lighting. In non-Government concerns local rates, rents, etc., would similarly bear on this item.

It is evident that it is very seldom that a locality will be found in which all the above considerations can be satisfactorily met. For instance in one place railway freights may be low but labour dear, or *vice versâ;* in another land may be cheap, but the place may be inconveniently situated. It will generally be necessary to balance the advantages and disadvantages of alternative localities, noting which of the considerations has the greater influence on the financial working of the establishment. Often, however, considerations of army organization, of strategy, or of security from hostile attack, will be the governing factor in the decision.

Assuming now that the locality is decided, we may return to the subject proper of this article, namely, an examination of the manner in which the design and arrangements of the buildings and other works of the factory affect the cost of the project.

The main general principle to be borne in mind in these cases is that the arrangements must be such as to reduce to an absolute minimum the transport or movement, and the handling in any way of the materials during the process of manufacture. In the great majority of manufactures the cost of the materials is comparatively small in proportion to the labour required in its conversion to the finished article. It is not only in western countries, where labour is

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dear and materials cheap, that this is the case, but it is also so, though in a somewhat less degree, in the east, where materials may have to be imported from Europe and wages are extremely low.

The first requisite therefore, if operations are going to be on anything of a large scale, is a standard gauge railway siding right into the works. In a very few years indeed the capital cost of the siding will be recovered by the saving in charges for cart transport, shifting from railway wagons to carts, and the waste or breakage which often accompanies such operations. In cases where the material is to be kept on stock for some time before being used, the siding will run into the yard or sheds, where it will be stored, but if it is to be used directly on arrival, it is economical to carry the siding right alongside the shop or other place, where the first operation will be performed on the material. In any case where bulky or heavy articles are sometimes dealt with—such as guns for re-tubing—a siding into the shop is required, in addition to the branches into the store yard for the lighter articles.

It is an advantage to have the line at the unloading places in about 3 feet of cutting, or the floors of the store sheds may be made up to ordinary platform level so as to facilitate unloading; but this may not always be practicable, as it may affect the subsequent movement of the materials. Cranes, hand or power, according to the materials dealt with, will usually be provided for unloading goods.

Similarly, for removal of the finished products, the siding must be run alongside the place where the last process is performed, so that no intermediate handling is necessary before it is transferred to the railway wagons. Also a branch siding will be required alongside the coal bunkers where the fuel supply for the power house is kept. Double sidings with crossovers should be provided, wherever it is possible that wagons unloading may block access to other parts of the yard. Delays may be caused to the work if a sufficiency of passing places have not been provided.

While on the subject of sidings it may be mentioned that in a factory yard gradients of any sort should be avoided as far as possible, and if practicable the siding system should be dead flat. There is bound to be a good deal of hand shunting of wagons, and even a slight grade may, in such circumstances, lead to accidents. Another point is to take care, when setting out the sidings on the plan, that the curves are practicable as regards radius. The minimum curvature admissible will depend on the maximum rigid wheel base of the locomotives and rolling stock to be employed, and the necessary information can be obtained from the railway company which will supply them. Sometimes in large works special yard engines are employed, or a locomotive crane may use the sidings; in such cases the suitability of the curves to the special engines should be

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ascertained. If this precaution is neglected the planning may be seriously affected at a later stage.

The arrangement in relation to each other of the various shops or buildings where the processes are to be carried out, should be such that the operations performed on the materials form a continuous progress from the first stage to the last. Thus the shop nearest the point where the materials enter the works should be that where the first process is carried out; the next should be for the next process, and so on. The path taken by the material, in transit from shop to shop, should be as short and direct as possible; circuitous or zigzag routes should be avoided, and on no account should the material have to return and go twice over the same line. The aim is to secure a steady continuous "flow" of the work in one direction. The longer axes of the shops should, when practicable, be arranged to facilitate this "flow," and the arrangement of the machines inside them should as far as possible be on the same principle. For instance, in a shop where riveted steel work is to be made up, the marking-out benches should be near the end where the material enters, the punches would be next, then the reamers and drilling machines, and the hydraulic or pneumatic riveters near the exit. It would be a bad arrangement to have to carry the plates and bars past all the machines to the marking-out tables, then bring them back to the punches and drills, and then return again to be riveted up.

The means selected for transportation about the factory of the materials and parts, will depend on the nature of the latter. For heavy and bulky articles, and where the factory covers a large area, the standard gauge sidings will probably be used, a locomotive crane being very economical in such cases. For light loads, small gauge tramways with trolleys for man haulage will often be suitable, and the various shops will be connected by a network of these. Inside the shops there will no doubt be overhead travelling girder cranes of a capacity to suit the objects handled. The lines of rail or tram which bring the articles up to the shops should carry them under the cranes, so that the latter can take them to any of the machines in the shop. For light loads up to one or two tons overhead runways with pulley blocks are of very great service. The runway is generally an ordinary I joist, and the pulley is suspended from a little carriage which runs on the lower flanges. These runways can be carried round curves, and automatic switches permit of turning out on to branches. They are therefore extremely useful, as they permit of articles being delivered to machines in almost any situation. In small establishments they can be used all over the works, outside as well as inside the shops. The arrangement of the various classes of transporting gear should be such that manual lifting and handling is reduced to the minimum.

The buildings should be placed fairly close together, both in order

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to reduce the distances traversed by the materials and to economize in the area of land to be purchased. On the other hand it is important not to crowd them so as to cramp further development. Institutions of this nature are almost certain to grow in course of time, and very great expense and inconvenience will be entailed if space has not been left for extension. To argue, as some do, that extension will never be necessary, because it cannot be foreseen at the present moment, is to display a lamentable shortness of sight. One has only to consider any of our present manufacturing establishments, and ask oneself whether 30 years ago they were of the same extent as they are now, and what grounds there are for assuming that the development of the Army and its administrative services is about to cease.

The question of the supply of power to the different machines is one that may require a good deal of consideration. If electric power is used, a central station will be best, but for steam, gas, or oil engines, and for hydraulics and pneumatics, the closer the source of power to the place where it is used the better. With machinery driven off lines of shafting, as is generally necessary with steam, oil, or gas as motive power, there is the disadvantage that energy is wasted in turning the shafting and overcoming friction in gearing, and that even when machines are not in use power is wasted in uselessly turning shafting. Electricity can often be applied direct to machines without shafting, and when the motors are not running no power is used. On the other hand electric power is more costly to generate than that from steam or oil or gas, so from this it may sometimes happen that for machines used intermittently, electricity would be cheaper; while for machines for continuous heavy work, the other agents might be the cheaper; although the other advantages of electricity, particularly the power of applying it in any situation and even to portable tools, may often outweigh the difference in cost. For certain work hydraulic or pneumatic power is particularly suited, such as (in the case of engineering works) to presses, punches, riveters, chipping hammers, and others with reciprocating instead of rotary motion. The whole question is entirely one for practical consideration according to the requirements of each case, and in large works it might pay to have two or three different descriptions of power to deal with different classes of work.

A few words will not be out of place on the design of shops—not as regards details, but only in so far as it affects economic principles. As soon as circumstances require the width of a shop to exceed a certain amount, it becomes necessary, in order to avoid excessive and eventually prohibitive cost, to divide it into two or more spans. In many cases, however, the existence of the lines of stanchions between these spans is a considerable objection. Travelling cranes can work along each span, but movement of loads from one span to another is

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a matter of difficulty. Overhead runways are very useful for this purpose, but they can only deal with light loads. Although in some cases the stanchions will be unobjectionable, or even of advantage in affording supports for shafting, yet in cases where large pieces have to be handled they may be extremely in the way. The question of whether to adopt two or three large spans or a larger number of smaller ones may thus be one of considerable moment. Besides the increased cost of the roofing in the larger spans, that of the travelling cranes also rises considerably, both in initial cost and in power required to work them. Generally speaking, except when special circumstances require in any case an extra large span, it is desirable to give all the shops in a factory bays of the same roof span. This will tend to simplicity, will lessen the cost of roof trusses (since repetition work is always cheaper than different designs), will admit of interchangeability of cranes and travellers, and will enable the latter to be run direct from one shop into another, as will be described later on.

To describe in any further detail how the economic principles referred to above may be applied in practice to the planning of a factory or works yard, would be a matter of difficulty. It may, however, be possible to throw a light on it by means of an illustration.

The accompanying diagram is a block plan representing a large factory or work yard, where it is assumed—for the sake of illustration—that the raw materials are timber, and steel or iron. It makes no difference in principle whether the products are railway wagons, rifles, barrack furniture, gun carriages, or anything else which has the above materials for its constituents. It should be understood that this plan is a purely imaginary one, and does not resemble any establishment with which the writer is acquainted. Exigencies of site generally prevent the adoption in their entirety of the arrangements which would be most suited to economic working. It is not, however, claimed that this plan is an ideal one. An experienced works manager would, no doubt, be able to point out defects in it and to suggest improvements. It is merely intended as a graphic method of expounding the general principles previously discussed.

We may do this by following the progress of the materials from the time they enter the factory. Close to the point of entrance we find first of all the wagon weighbridge, with a small office for the clerk who receives, issues, and checks the consignments coming in and going out. It may conveniently be on a short branch or loop, so that the weighbridge may not be constantly run over by vehicles which it is not required to weigh. The timber conversion processes are shown as taking place up the left side of the works. It is assumed that the timber arrives in logs, or large baulks, and that a considerable stock is kept to allow of a period of seasoning before it is cut up. This necessitates a timber yard where the logs or baulks are stacked,

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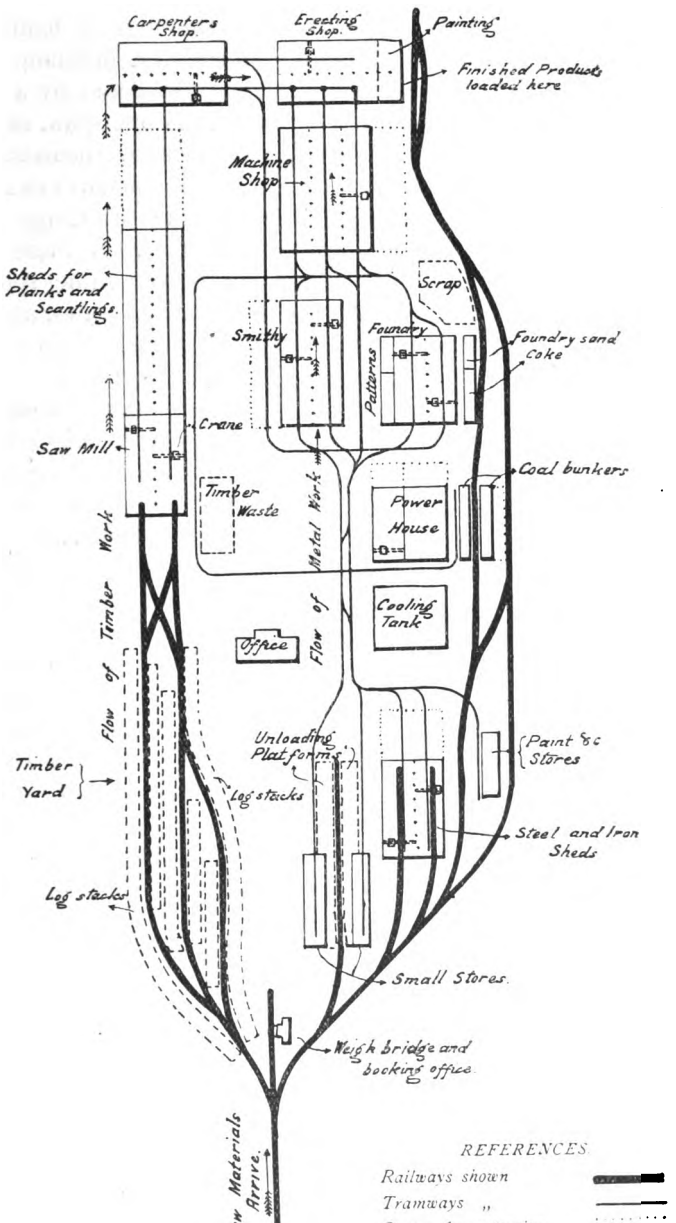
PLAN OF A FACTORY

Illustrating Economic Principles in Planning.

Scale—Approximately 155 Feet=1 Inch.



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and this must be served by sidings, arranged so as to get the maximum of stacks into the minimum of area. About 60 feet of space between sidings, will permit of a double line of log stacks, and a locomotive crane working on the sidings can pile up, or pick off, logs very conveniently.

The first operation to be performed on the logs or baulks is to convert them into scantlings or planks, so the first building next to the timber yard will be the sawmill. It is connected by a railway siding with the timber yard, and, if in more than one span, the siding should be arranged so as to serve both, so that the overhead travelling cranes can pick up the logs and take them to the various saws.

Next to the sawmill are the sheds where the scantlings, planks, etc., are stored, and undergo a further seasoning. If these can be made in prolongation of the sawmill, and of the same spans, the travelling cranes can take the cut pieces from the saws, and carry them straight to the stacks in the scantling sheds. This will be a considerable advantage. A tram line down the centre of the bays will also be useful for light loads. Somewhere near the sawmill a shed or enclosure is required to deposit the sawn outsides of logs and other waste pieces from the saws. These would be disposed of perhaps by sale, or perhaps by consumption in the boilers of the power house. A tram line to the latter place will facilitate this.

Beyond the scantling and plank sheds, we come to the carpenters' shop, fitted probably with benches, circular saws, planing, grooving, and rebating machines, and any other special plant required for the manufacture in view. Here again it would probably be an advantage to site this building with its long axis in prolongation of the scantling sheds, so that the travelling cranes can bring the material direct to the machines; but site considerations will seldom allow of a series of large shops to be arranged end on to each other. It will probably not be necessary to carry heavy loads from the scantling sheds to the carpenters' shop, so that tram lines or overhead runways will generally afford a sufficient connection between the two. Moreover the relation of the carpenters' shop to the one where the next operation will be performed, has to be considered, and this also affects the siting. Before proceeding to this, however, we will, as we have now reached the penultimate stage in the timber portion of the manufacture, leave it for the present and go back to the steel and other metals.

The steel and iron will arrive in bars, blooms, plates, etc., and sheds will be required for its storage. Also closed sheds will no doubt be wanted for small stores, paints, etc. These buildings should be sited so as to fit in with the economical arrangement of the sidings which serve them. If they are sited and built without reference to the sidings, there may be difficulty in bringing the latter to them later on, and the area occupied will be greater than it need

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be. Sidings may conveniently be taken right inside the sheds for storing steel, where a travelling crane can unload the bars and carry them to their place of storage. An enclosure for scrap and pig for the foundry will be required, but it will probably be convenient to place these near the foundry and smithy, rather than with the other stores.

The power house has to be placed somewhere, and in the plan it is shown next after the iron and steel stores. It might, however, be better to place it more centrally in regard to the various shops where the power is used, though with electricity the loss in a work yard, even of fairly large size, would be inappreciable.

The iron and steel will first be dealt with either in the foundry or in the smithy. The latter will contain the forges, hammers, presses, and similar plant. The foundry is so placed that its coal and coke bunkers, and the store for sand, may be served by the same siding as the power-house bunkers. From these two shops the castings and forgings will go to the machine shop, in which are the planing, shearing, bending, punching, drilling, and suchlike machines, and the lathes. In this case again, as on the timber side, facility of transport from the two former to the latter shop, has to be sought for. It would not be possible to have a traveller from both of them into the machine shop, but it would be practicable to arrange it from one of them, choosing, if other conditions permitted, the one from which the greater weights have to be carried. It is to be remembered that to run an overhead travelling crane from one shop into another, it is not necessary that they should be touching each other, as the traveller can be carried on a gantry across the open space between.

Last of all comes the shop where the metal component parts from the one side, and the wooden component parts from the other side, are assembled, fitted, put together, and made into the final finished article. This shop requires to be sited for convenience of access from both the machine shop and the carpenters' shop, overhead cranes, or tram lines, or runways being used as circumstances dictate. The painting of the finished article may be carried out on a portion of the erecting shop, or a separate painters' shop may be provided contiguous to it. The product is then in a finished state, and only requires to be loaded on to the railway wagons on the siding, which is provided close alongside the place where the final operation is performed.

It has now been shown how economic principles enter into the planning of a factory for a certain class of output, and it is not difficult to see how the same principles may be applied in the case of manufactures of an entirely different character. Whether the operations under consideration are to be on a large scale or a small scale, and whatever are the materials to be dealt with, it will be possible so to arrange the design as to reduce to a minimum the handling, lifting, and carriage of the materials, and to secure the continuous "flow" of the

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latter in one direction. In small works in particular, which are carried on in single buildings, this last principle is of particular importance, and care should be taken that in any particular room or shop the flow of material in one state of manufacture does not cross the line of flow of another stage of the manufacture, since such an arrangement will generally interfere with the mechanical arrangements for transporting the materials and will cause confusion and delay in the operations, and both of these are opposed to economy.

In works comprised in a single building of several storeys, it is generally economical to raise the raw material to the top storey by a hoist, starting the manufacturing processes there, and letting the materials descend by gravity from storey to storey, undergoing successive operations till they arrive completed on the ground floor. We have heard how, in the great Chicago packing establishments, the live animals are driven up an inclined plane or ramp, slaughtered at the top of it, and as the carcasses are carried down the opposite side on runners, all the operations necessary to prepare them for the market are carried out.

In the organization of the arrangements for the execution of large engineering or building works, the principles to be kept in view are precisely similar to those already described. In the removal of excavated earth, the formation of banks, the mixing of concrete and its conveyance and deposit in site, the lifting of materials and heavy articles such as stone or steel, hand labour has long been superseded by trolley systems, either on the ground or on gantries and by hoists, mechanical mixers, and such contrivances. In the arrangement of these we require in the same way to avoid the necessity for twice handling or picking up spoil and materials, and to arrange that the flow of the latter is continuous, direct, and in one direction.

It will be evident, from a consideration of the conditions to be borne in mind by the designer of an establishment for manufacturing purposes, that the fullest co-operation and consultation between the latter and the persons who will superintend the working of the factory is necessary. The designing engineer is not likely to be acquainted with the details of the processes that will be employed in all the establishments he has to plan, and no one but the experienced manager can tell where labour may be saved and economy effected by judicious planning. Moreover the question is intimately bound up with that of the nature and amount of the machinery and plant to be used.

At the same time it would not as a rule be expedient for the engineer to comply blindly with every demand of the manufacturing staff. One of the inevitable defects of Government methods is that the administrative services have a tendency to work in what have been aptly termed "watertight compartments." Thus the manu-

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facturing departments naturally desire to have installed every convenience that will facilitate their operations, and may sometimes not sufficiently consider the question of whether the anticipated saving in recurring expenses, is commensurate with the increased capital cost involved. On the other hand, the building department, who has to provide the funds for the capital outlay, naturally desires to keep the latter down, and may possibly not give due weight to ultimate savings which may be obtained by an increase in initial cost. The only proper point of view in such cases is the financial one. When, therefore, the manufacturing department asks for additional buildings or plant, or for an alteration in the planning, which will seriously affect the cost, they should be asked to show that the actual saving which they anticipate in labour charges will at least equal the interest on the additional capital cost involved. The most alluring propositions often look very different when reduced to cold hard figures. Hand-in-hand working of the two departments concerned is of the highest importance, but each must learn to consider the undertaking in its entirety, not only its own share in it, and to this end each must look at it from the other's point of view.

Excessive capital cost is an important point to guard against in inaugurating a manufacturing institution. In the commercial world, over-capitalization means reduced dividends, and often leads to failure and liquidation. Notwithstanding that this result is clearly in view, it is one of the commonest mistakes made, and is probably more often the cause of failure than anything else. The tendency of the present day is all towards over-capitalization. From what one often sees it would appear that an institution cannot consider itself modern and up to date without substantial buildings, handsome—sometimes palatial—offices, all the latest inventions in plant, and "everything of the best" all round. Whatever may be said for this in the case of a private business from the point of view of advertisement—and that probably is very little—there is no possible justification for it in the case of Government business, which does not require to advertise itself. Although in the latter case neither the necessity for dividends nor the fear of bankruptcy need be borne in mind, yet the financial principle which governs the sound investment of national funds is exactly the same. The secret of the successful conduct of a commercial enterprise lies in restricting the capital invested in it to the absolute minimum required to earn the largest percentage on the outlay. In Government enterprises every pound expended beyond this minimum is a wanton diversion of national funds from other directions where they are urgently required.

One direction in which the danger of excessive capital cost must be rigorously guarded against, is in the nature of the buildings provided. One often sees brick or stone buildings of solid construction, in every way fitted to last a couple of hundred years, and yet it is quite

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probable that in less than a quarter of that time they will be entirely out of date, will have to be abandoned, or, at all events, entirely remodelled in order to fit them to the altered requirements of the time. Mechanical sciences, manufacturing methods, and constructional materials are constantly changing. Systems that were only introduced 30 years ago are dead to-day. Every great war leaves an after effect on military equipment, and details in the organization, numbers, and distribution of the Army constantly change with the changes in military opinion. Who can say of what materials, by what processes, and in what locality, any military equipments will be manufactured a generation hence? In the accounts of engineering and manufacturing companies five per cent. depreciation is generally allowed on buildings. This means that their owners only look to a life of 20 years for them. It is not likely that this is because they anticipate their wearing out in that time, but that the evolution of the trade methods will necessitate their reconstruction. Now bricks and mortar in 20 years have only got through about a tenth of their natural life, and buildings of this material are uneconomical and expensive to remodel. Ferro-concrete, though it may be cheaper in first cost for buildings of a certain type than brick, is otherwise open to exactly the same objection.

In the present stage of development of constructional methods steel framing seems to be the most suitable form for factory buildings. Even if brick or concrete is used to fill in the sides, the walls will be lighter in section and require less foundations than if they supported the roof. They can be pierced or removed in any way for extensions or alterations without affecting upper floors or roof. Cheaper materials than brick will, however, usually answer all purposes. Corrugated iron sides and roof covering is suitable for workshops in many cases. In hot climates, or where furnaces are concerned, the sides may be filled in with sloping sheet-iron slats, which exclude sun and rain and admit air. Such buildings are cheap, will last quite as long as they are likely to be required, and when reconstruction is necessary can be extended without difficulty; if necessary the framing can be taken down and rearranged on another plan to suit modern needs, or even put up in another place. Steel construction has also the advantage that it affords facilities for the attachment of shafting, for gantry ways for travelling cranes, for lifting tackle, and for securing machinery. It adapts itself particularly to the needs of large shops which have to be in several spans.

It will be evident that, in work of this sort, the material and labour put in should be only just what is required to do the work and no more. Everything spent on unnecessary strength and durability, on appearance or finish, is wasted. It is even more important than in the case of other buildings, rigorously to proportion the means employed to the end in view. This after all is the true function of

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the engineer. Anyone can put up a building, but it takes an engineer to design one that is exactly adapted to the purpose for which it is built, with the minimum expenditure of money and time. Let the designer, however, expect little credit and no glory in return for his efforts. No massive pile, no handsome façade, will advertise his skill, or cause the visitor to ask his name. To the uninitiated the results will be a collection of great ugly sheds; the subordinate members of the manufacturing establishment will complain because they cannot hang 5-ton loads to the truss tie-bars; to the managing staff the economy effected will not appeal, and if by chance in his zeal for economy in initial cost—dictated probably by stringent orders from headquarters—he has in a few cases run his calculations too fine, with the result that some structural members have buckled or some foundations settled, he will come in for more than his fair share of blame. But he has the satisfaction of knowing that the brother expert will recognize the nice proportionment of the parts, will realize the difficulties overcome, and will award the credit where it is due.

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THE FIRST MOUNTED UNITS OF THE CORPS ORGANIZED AT CHATHAM.

By LIEUT.-COLONEL B. R. WARD, R.E.

THE first mounted unit of the Corps was organized at Chatham in 1855, and was trained at the Royal Engineer Establishment for the next 16 years. These units now include field companies, balloon companies, field troops, and telegraph companies (air line, cable, and wireless).

Of these the first two originated at Chatham; the remainder were organized at Aldershot, now the headquarters of all R.E. mounted units.

Pontooning was one of the earliest subjects taught at the R.E. Establishment. During Pasley's time however, and for many years afterwards, no attempt was made to organize complete companies of Sappers capable of carrying bridging equipment in the field. One of the reforms most strenuously advocated by Pasley, was that Engineer units should be organized with their own horses and drivers complete. The experience of the march to Paris, after the Waterloo Campaign, had sufficiently demonstrated the inconvenience and inefficiency inseparable from the system of hiring horses and civilian drivers for work in a campaign. It was not however until the further experience of the Crimean War had again proved this almost self-evident proposition, that steps were at last taken to carry out Pasley's recommendations on this point.

In the *Official Account of the Siege of Sebastopol*, Part I., "Engineer Operations," page 149, will be found a memorandum by Sir John Burgoyne, then in his 72nd year, and C.R.E. in the Crimea. In this he recommends the establishment of a "Royal Engineer Train," and his recommendation having been adopted by the War Department, the organization of the new unit was entrusted to Capt. H. T. Siborne in 1855, Lieut. H. Savile being appointed Adjutant, R.E. Train, in the same year. Lieut. Savile was succeeded by Lieut. Mathias Moore in 1859, and in 1868, when Sir Francis Head visited the R.E. Establishment at Chatham, Capt. R. W. Duff—who had been posted to the train when it was first organized in 1855—was in command of it, Lieut. A. K. Haslett being his adjutant. The organization of the R.E. Train is described by Sir Francis Head on pp. 180 to 182 of his chatty book, *The Royal Engineer*, published by John Murray in 1869. It was divided into two troops, lettered A and B.

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A—the Pontoon Troop—was in 1868 commanded by 2nd Capt. E. Micklem. An illustration facing page 34 of *The Royal Engineer* shows A Troop in column of route with two cylindrical Blanshard pontoons on each wagon. Until 1862 pontooning had been carried out in the Medway close to the barracks, but the extension of the Dockyard in that year, necessitated the provision of a new practice ground. A piece of ground some 27 acres in extent, and on the Medway, was therefore purchased by the Government at Wouldham, a village some three miles above Rochester. It was here that A Troop was annually encamped, until the headquarters of the R.E. Train were moved to Aldershot in 1871, and there reorganized by Colonel FitzRoy Somerset, who was specially sent from Chatham to take up the appointment of Commandant of the R.E. Train.

In 1868 A Troop consisted of 1 captain, 3 subalterns, 122 N.C.O.'s and sappers, 95 drivers, and 140 horses. It carried 24 pontoons on its 12 wagons, and could lay a bridge 100 yards long capable of taking infantry in fours. A Troop (Pontoons) continued to exist until 1888, when it was reorganized as the Bridging Battalion.

B Troop—the forerunner of the original field companies—was in 1868 under the command of Lieut. G. W. Tisdall.

An illustration, showing B Troop on the march, forms the frontispiece to *The Royal Engineer*. In its 22 two-horse carts and 11 four-horse wagons, as well as on the backs of its 30 pack horses, it carried entrenching and technical tools and stores. Like A Troop, it was divided into three sections, each one of which could be detached under the command of a subaltern.

The complete establishment of B Troop in 1868 was as follows :—1 captain, 3 lieutenants, 211 N.C.O.'s and sappers, and 145 horses. Sections both of A and B Troops were detached at Aldershot for work in the camp—being employed on work in connection with the construction of huts, rifle ranges, etc.—throughout the period 1855 to 1871. On this latter date the R.E. Train in its entirety—comprising both A and B Troops—was moved to Aldershot, which has ever since been the headquarters of the mounted branches of the Corps.

A portion of B Troop remained on detachment at Chatham until 1878. In that year the first field companies—the 2nd, 5th, 17th, and 31st—were organized at Chatham, the Curragh, and Shorncliffe, the horses of B Troop being transferred to them. From that date B Troop (Equipment), to give it its full official title, ceased to exist.

A detailed account of the origin and progress of ballooning in the British Service is given in a Paper by Colonel C. M. Watson, C.B., C.M.G., published in Volume XXVIII. of the *Professional Papers*, and the following notes are compiled principally from this source.

The first balloon factory was established at St. Mary's Barracks in 1882. Experiments had been carried out by Lieut. C. M. Watson,

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R.E., at Woolwich Arsenal as early as 1872, in order to determine the best apparatus for the production of hydrogen gas.

In 1882 further experiments were carried out at Chatham under Capt. H. P. Lee, who was in command of the 38th (Depôt) Company. In 1884 a Balloon Detachment, under Major H. Elsdale, accompanied Sir Charles Warren's expedition to Bechuanaland. Another detachment was sent out to the Soudan in 1885 under Major J. L. B. Templer, of the 7th King's Royal Rifles. In the summer of 1885 the two detachments returned to Chatham, and in 1886 Major Templer purchased some land at Lidsing, about five miles from Chatham, where summer camps for the Balloon Detachment were held for the next three years.

In 1887 Major Templer was gazetted Instructor in Ballooning, and in 1889 the Balloon Detachment took part in the Aldershot manœuvres under Sir Evelyn Wood. As a result of his report it was decided to introduce ballooning definitely into the British Service. A Balloon Section was accordingly authorized in the Army Estimates of 1890–91, and the Balloon Factory and School were removed from Chatham to Aldershot in 1892, and have remained there since that date.

OFFICERS OF THE R.E. TRAIN AT CHATHAM.

OFFICERS COMMANDING R.E. TRAIN.

Capt. H. T. Siborne	1855-1863
Lieut. R. W. Duff	1863-1871

ADJUTANTS, R.E. TRAIN.

Lieut. Henry Savile	1855-1859
„ Mathias Moore	1859-1864
„ A. K. Haslett	1864-1869
„ Sir A. Mackworth	1869-1873 (at Aldershot).

BALLOONING OFFICERS AT CHATHAM.

OFFICERS COMMANDING BALLOONS.

Major H. Elsdale	1884-1888
„ C. M. Watson	1888-1889
Lt.-Col. J. L. B. Templer (7th K.R. Rifles)	1889-1891

INSTRUCTOR IN BALLOONING.

Lt.-Col. J. L. B. Templer (7th K.R. Rifles)	1887-1891

OFFICERS COMMANDING BALLOON DETACHMENT.

Lieut. B. R. Ward	1889-1890
„ H. B. Jones	1890-1891

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In 1891 the Balloon School was moved to Aldershot.

The following officers were employed in connection with balloons at Chatham :—

Capt. H. P. Lee	1882-1884
Major J. L. B. Templer (7th K.R. Rifles)	1882-1891
Lieut. Trollope (Grenadier Guards) ...	1883-1885
Major H. Elsdale	1884-1888
Lieut. J. R. L. Macdonald	1884
„ R. J. Mackenzie	1884-1886
„ G. E. Phillips	1886-1888
„ C. F. Close	1887-1888
„ H. B. Jones	1887-1891
„ B. R. Ward	1888-1890
„ A. B. Hume	1890-1891

ERRATA

In last month's article on the Electrical School :—

Page 32, line 22, *for* "Capt. J. C. L. Campbell" *read* "Capt. C. A. Lyon-Campbell."

Page 36, line 21, *for* "Capt. A. F. Le Mesurier" *read* "Capt. F. A. Le Mesurier."

Page 36, line 22, *for* "Capt. J. C. L. Campbell" *read* "Capt. C. A. Lyon-Campbell."

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TRANSCRIPTS.

A PROPOSED NEW METHOD OF MEASURING THE RESISTANCE OF PROJECTILES.

By C. E. WOLFF, B.SC., A.M. INST. C.E.

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THE resistance offered to a bullet in its flight through the air is in the nature of things incapable of direct measurement. The only methods at our disposal are to measure the change of velocity over a short interval of time or distance, and to calculate the resistance from the figures thus obtained. In practice we are confined to the measurement of change of velocity over a measured distance, as the screens from which the chronograph is actuated must be fixed points.

From the above considerations it will be seen that the retardation of the bullet is of the nature of a second difference in the time required to reach the fixed points (or screens), and, therefore, an extremely small error in the time measurements may result in a very serious error in the calculated resistance.

In the case of the tables for the resistance offered to a standard bullet at different velocities given in the *Text Book of Small Arms*, which are obviously calculated from Mr. Bashforth's classic tables, the probability of error is very great. Indeed, an error of one-thousandth of a second in the case of a velocity of 2,400 feet per second will lead to an error of 10 per cent. in the value of the resistance, and from its design it is very unlikely that Bashforth's chronograph could be relied upon to more than one-fourhundredth of a second at the outside. Errors of 25 per cent. are, therefore, quite possible, and although this figure will be reduced by repeating the experiments, the probable error is still very considerable. Thus, if every measurement was repeated six times, the probable error will still be about 10 per cent., and this without taking into account the variation in the ammunition.

A consideration of the above points has suggested the following investigation as to whether we are not likely to obtain better results from a study of the angles of elevation required for different ranges, since this is by far the most accurately known characteristic of the trajectory. It will be seen from what follows that if we can express the tangent of the angle of elevation as an algebraic function of the range, the results are extremely promising.

Form of Equations.—Let OPM (*Fig.* 1) represent the curve of the trajectory, and let P be any point on the same. OA represents the initial direction of motion making an angle α with the horizontal. We

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will write x for the horizontal distance from the origin O, and y for the distance measured vertically *downwards* from OA. Thus at the point P $OX = x$ and $AP = y$.

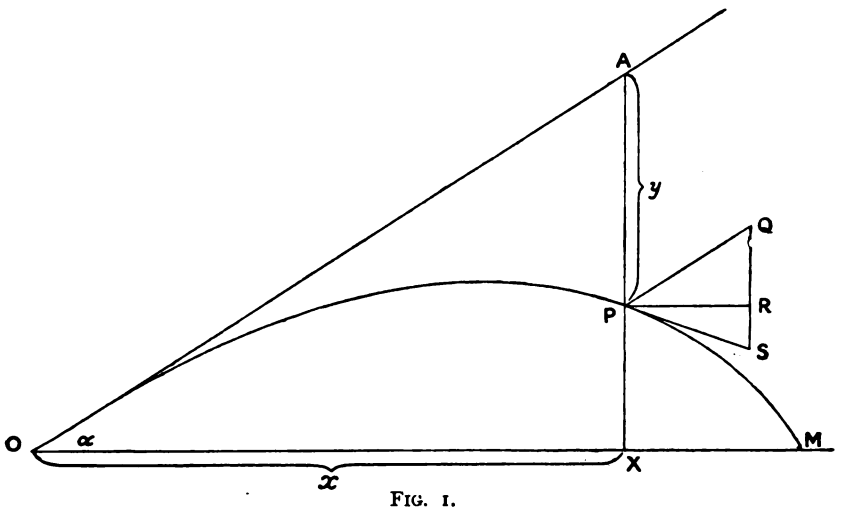

FIG. 1.

Then considering the forces acting at P we have

$$\frac{d^2y}{dt^2} = g - \frac{SR}{PR} \cdot \frac{d^2x}{dt^2}$$

And since

$$\frac{QS}{PR} = \frac{dy}{dx}$$

$$\frac{d^2y}{dt^2} = g - \left(\frac{dy}{dx} - \tan \alpha\right) \frac{d^2x}{dt^2}$$

Multiplying by $\frac{dx}{dt}$ and transposing this becomes

$$\frac{dx}{dt} \cdot \frac{d^2y}{dt^2} + \frac{dy}{dt} \cdot \frac{d^2x}{dt^2} = g \cdot \frac{dx}{dt} + \tan \alpha \frac{dx}{dt} \cdot \frac{d^2x}{dt^2}$$

Integrating this equation we get

$$\frac{dx}{dt} \cdot \frac{dy}{dt} = gx + \tfrac{1}{2} \tan \alpha \left(\frac{dx}{dt}\right)^2 + c$$

or

$$\left(\frac{dx}{dt}\right)^2 \left(\frac{dy}{dx} - \tfrac{1}{2} \tan \alpha\right) = gx + c$$

where c is the constant of integration.

Now write v for the horizontal component of the velocity and v_0 for the horizontal component of the initial velocity. Then putting $x = 0$ we have (since $\frac{dy}{dx}$ also $= 0$ when $x = 0$)

$$c = -\tfrac{1}{2} \tan \alpha, v_0^2$$

$$\therefore \quad v^2 \left(\frac{dy}{dx} - \tfrac{1}{2} \tan \alpha\right) = gx - \tfrac{1}{2} \tan \alpha \cdot v_0^2$$

$$\therefore \quad v^2 = \frac{2gx - \tan \alpha \cdot v_0^2}{2 \frac{dy}{dx} - \tan \alpha}.$$

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Now if we take a table of elevations necessary for different ranges, we find that tan α can be very accurately expressed in the form ar^3+br^2+cr+d, where r is the range on level ground, *i.e.*, the value of x when the bullet is in the same horizontal plane as the point of projection. Indeed, in the case of Metford's Table, the relation is an exact one. From this we notice at once that since tan $\alpha=o$ when $r=o$, therefore $d=o$, and if in any series d does not disappear, it must be that the rifle is not exactly aimed in the supposed direction when the bullet leaves the muzzle; that is to say, d is the "jump" or "flip" of the rifle due to barrel vibrations, etc.

Further, if h is the height of the line of projection above the horizontal plane through the point of projection when $x=r$

$$h=r\tan\alpha$$

$$=r^2(ar^2+br+c).$$

Also $\frac{dy}{dx}$ becomes $\frac{dh}{dr}$ at this point.

$$\therefore \qquad \frac{dy}{dx}=r(4ar^2+3br+2c).$$

Substituting these values in the equation for v^2, we get

$$v^2=\frac{2gr-r(ar^2+br+c)\,v_0^2}{2r(4ar^2+3br+2c)-r(ar^2+br+c)}$$

$$=\frac{2g-(ar^2+br+c)\,v_0^2}{7ar^2+5br+3c}$$

When $r=o$ this reduces to

$$v_0^2=\frac{2g-cv_0^2}{3c}$$

or

$$v_0^2=\frac{g}{2c}$$

and hence

$$v^2=\frac{g}{2c}\cdot\frac{3c-ar^2-br}{7ar^2+5br+3c} \qquad \ldots\ldots(1).$$

It must be noted that this relation is only strictly accurate on condition that the bullet is in the same horizontal plane as the point of projection. It will, however, be nearly exact as long as the difference of level is small, since the vertical forces are very small compared to the horizontal resistance.

To find the resistance we have

$$\text{Resistance}=-\frac{W}{g}\cdot\frac{dv}{dt}=-\frac{W}{g}v\frac{dv}{dr}=-\frac{W}{2g}\cdot\frac{d(v^2)}{dr}$$

$$=\frac{w}{4c}\cdot\frac{(7ar^2+5br+3c)(2ar+b)+(3c-ar^2-br)(14ar+5b)}{(7ar^2+5br+3c)^2}$$

$$=\frac{w}{2c}\cdot\frac{abr^2-24acr-9bc}{(7ar^2+5br+3c)^2} \qquad \ldots\ldots(2).$$

Hence by taking a number of ranges we can obtain corresponding values for the velocity and the resistance, and plot the results in the form of a curve.

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It must, however, be noted that v_0 is the horizontal component of the initial velocity, and that this has been taken as constant. This is quite sufficiently accurate as long as α is small, the error being under ·016 per cent. when $\alpha = 1°$.

Another point which should be borne in mind is that there will probably be a change in the law of resistance on passing through the velocity corresponding to that of sound, or about 1,100 feet per second. It will, therefore, be desirable to make all the experiments of one series either above or below this value.

First Results of the Method.—In order to test the formulæ obtained above, Table I. has been calculated from Metford's Table of Elevations for the ·303 Metford barrel. The figures have only been given up to 700 yards range, as beyond this the velocity falls below 1,100 feet per second.

The retardation is found by substituting g for w in the formula for the resistance, and from this the resistance of the 1-inch standard bullet has been calculated for comparison with the results given in the *Text Book of Small Arms*. The comparison is also shown graphically in *Fig.* 2, from

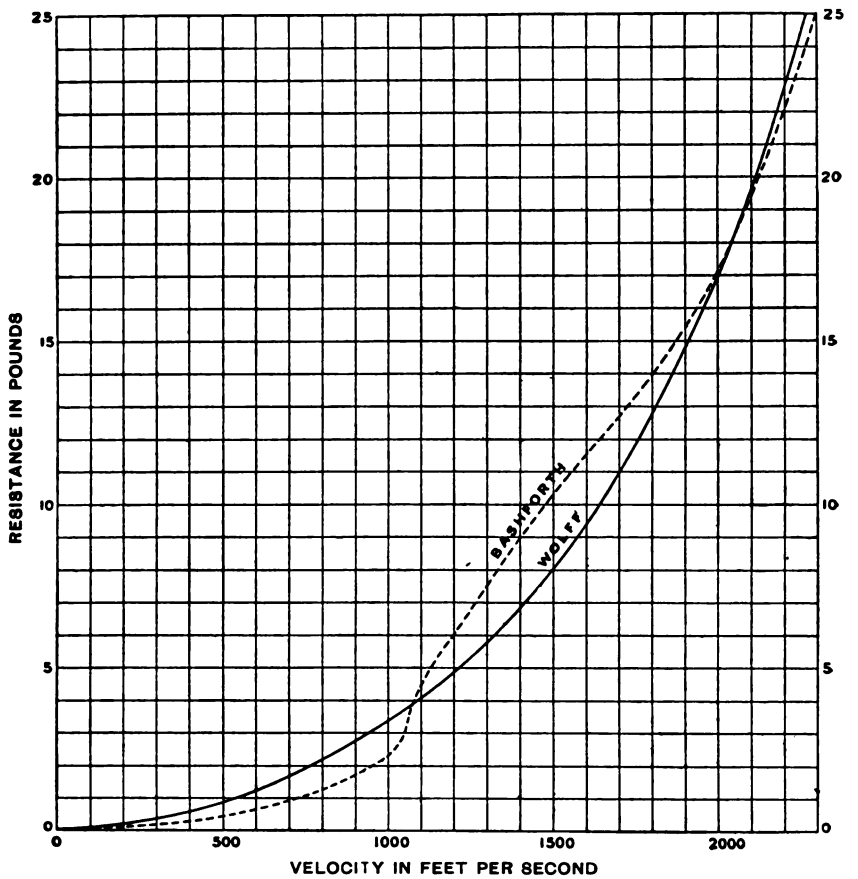

FIG. 2.

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which it will be seen that the results of the calculation from these formulæ form a smooth curve, which is a sort of mean of the curve calculated from Bashforth's Tables.

The exponent ρ is that power of the velocity with which the resistance is varying in the immediate neighbourhood of the corresponding value of the velocity. It will be noticed that it is about 2 when the velocity is 1,100 feet per second, and steadily increases as the velocity increases. As it is well known that the resistance varies as the square of the velocity at low speeds, and we have no reason to expect any change in this law until the velocity approaches that of sound, the lower part of the curve in *Fig.* 2 has been filled in as a parabola.

A very interesting point also arises out of these figures for resistance and velocity. This is whether we can find a simple expression for the resistance in terms of the velocity. With this object in view, a formula of the form

$$R = av^4 + bv^3 + cv^2 + dv + e$$

was assumed, and by putting in the corresponding values of v and R eight equations were obtained from which to find the values of the five coefficients. On doing this it was found that a became so small as to be quite negligible, and the remainder simplified into the form

$$R = 3{\cdot}5\ (v - {\cdot}992)^3 + 3{\cdot}36\ v^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3),$$

where v is expressed in *thousands of feet* per second.

The result is interesting as suggesting that the power of the velocity rises rapidly at first from a value of about 2 at the velocity of sound, and continues to rise at a decreasing rate until it approaches asymptotically to the value 3, when the velocity becomes infinitely great.

To return to the exponent ρ of Table I., this is found as follows:— We assume a curve whose equation is of the form $F = \gamma V^\rho$, and for any desired value of the velocity we calculate values of γ and ρ, such that when $V = v$, $F = f$ (the retardation of the bullet), and $\frac{dF}{dV} = \frac{df}{dv}$. Thus at the value of the velocity under consideration the assumed curve passes through the same point as the curve of retardation and velocity, and has a common tangent with it.

For the assumed curve

$$F = \gamma V^\rho$$

$$\therefore \quad \frac{dF}{dV} = \gamma\rho V^{\rho-1} = \rho\frac{F}{V}$$

$$\therefore \quad \rho = \frac{V}{F} \cdot \frac{dF}{dV} = \frac{v}{f} \cdot \frac{df}{dv}$$

But

$$\frac{df}{dv} = \frac{\frac{df}{dr}}{\frac{dv}{dr}} = \frac{\frac{df}{dr}}{\frac{1}{v}\frac{dv}{dt}} = \frac{\frac{df}{dr}}{\frac{f}{v}}$$

$$\therefore \quad \rho = \frac{v}{f} \cdot \frac{df}{dv} = \frac{v^2}{f^2} \cdot \frac{df}{dr}$$

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Now from (2) we have

$$f = (\text{Resistance}) \div \frac{w}{g}$$

$$= \frac{g}{2c} \frac{abr^2 - 24acr - 9bc}{(7ar^2 + 5br + 3c)^2}$$

and since $\frac{g}{2c} = v_0^2$ we may write this

$$f = v_0^2 \frac{f(r)}{[\phi(r)]^2}$$

Then $$\frac{df}{dr} = v_0^2 \left\{ \frac{(2abr - 24ac)[\phi(r)]^2 - 2f(r) \cdot \phi(r) \cdot (14ar + 5b)}{[\phi(r)]^4} \right\}$$

And $$\rho = \frac{v^2}{f^2} \frac{df}{dr} = \frac{v^2}{v_0^4} \cdot \frac{[\phi(r)]^4}{[f(r)]^2} \cdot \frac{df}{dr}$$

$$= 2\frac{v^2}{v_0^2} \left\{ (abr - 12ac) \cdot \left[\frac{\phi(r)}{f(r)} \right]^2 - (14ar + 5b \cdot \frac{\phi(r)}{f(r)} \right\} \ldots\ldots (4),$$

which is readily calculated since $f(r)$, $\phi(r)$, v and v_0 are already known.

The Converse Problem.—Having once obtained a curve connecting the velocity with the resistance or retardation, the question next presents itself whether we can obtain the values of a, b, and c in a simple form. If so, we can immediately find the values of the angle of elevation, the angle of descent, and the final velocity, if we know the range and the initial velocity.

This can be done as follows:—

We have already seen that $v_0^2 = \frac{g}{2c}$ and hence we have at once

$$c = \frac{g}{2v_0^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5).$$

Knowing c, we can next obtain the value of b from the expression for the retardation. If we put $r = o$ and $v = v_0$ this becomes

$$f_0 = v_0^2 \cdot \frac{b}{c}$$

or

$$b = \frac{cf_0}{v_0^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

where f_0 represents the initial value of the retardation.

Finally we have $\rho = \frac{v}{f} \cdot \frac{df}{dv}$ and is, therefore easily calculated.

Also when $r = o$, $\frac{\phi(r)}{f(r)} = -\frac{1}{3b}$, and therefore

$$\rho = 2\left\{ -12ac \times \frac{1}{9b^2} + 5b \times \frac{1}{3b} \right\}$$

$$= \frac{2}{3}\left(5 - \frac{4ac}{b^2}\right)$$

whence

$$a = \frac{b^2}{4c}\left(5 - \frac{3}{2}\rho\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7).$$

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Having thus obtained the values of a, b, and c, we have at once

$$\tan \alpha = (ar^2 + br + c)\, r \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8),$$

and if β is the angle of descent

$$\begin{aligned} \tan \beta &= \frac{dh}{dr} - \tan \alpha \\ &= (4ar^2 + 3br + 2c)\, r - (ar^2 + br + c)\, r \\ &= (3ar^2 + 2br + c)\, r \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9). \end{aligned}$$

The value of the final velocity is also given at once from Equation (1), and we are thus able to obtain immediately all the most usually required figures.

TABLE I.

Range, yds.	Angle of elevation, minutes.	Velocity, f.s.	Retardation, f.s. per s.	Resistance to standard bullet, lbs.	Exponent ρ
0	0	2038	1386	17·91	2·78
100	4·40	1851	1064	13·75	2·68
200	9·66	1691	839	10·84	2·57
300	15·81	1551	675	8·72	2·46
400	22·90	1428	552	7·13	2·35
500	30·99	1318	460	5·94	2·24
600	40·13	1218	387	5·00	2·13
700	50·36	1127	329	4·25	2·02

TABLE II.

Resistance of Standard Bullet from Formula (3).

Velocity, f.s.	Resistance, lbs.	Velocity, f.s.	Resistance, lbs.	Velocity, f.s.	Resistance, lbs.
0	0	800	2·15	1600	9·39
100	·03	900	2·72	1700	10·96
200	·13	1000	3·36	1800	12·74
300	·30	1100	4·06	1900	14·76
400	·54	1200	4·86	2000	17·04
500	·84	1300	5·77	2100	19·59
600	1·21	1400	6·81	2200	22·43
700	1·65	1500	8·01	2300	25·59

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THE KUNGCHULING POSITION OF THE 2ND ARMY.

Epitome of an article by Colonel S. A. Tsabel in the August, 1906, number of *Eenzhenernee Zhurnal.*

THIS position, which was fortified by the Russians towards the close of their campaign in Manchuria, was situated on the railway about 26 miles to the north of their main position at Hsipingai, to which it was intended to serve as a rear, or reserve, position. The section allotted to the 2nd Army, which is shown in the attached plan, is the right, or western, half of the position, the eastern half being occupied by the 1st Army, and the railway forming the dividing line between the sections.

The project of defence, which was drawn up after a brief reconnaissance by two captains, one of Engineers and one of the General Staff, was accompanied by a report which contained the following information:— The ground in front of the position was thickly overgrown with bushes and clumps of trees impeding the field of fire; a good supply of axes would therefore be required. The roads were good, but bridges and "drifts" required repair, and extra ones had to be made. There were no serious obstacles in the rear.

The western section—No. 4—from the village Tafanchen up to and beyond the Mandarin road, was cut in two by a ravine. Its defence should consist of strong works on the heights on either side and trenches in the valley. The work on the western height, with a fine field of fire westwards, would cover the right flank against a turning movement.

Section No. 2, from Tafanchen to Syaochenzi, also rested on two heights divided by a valley. Here again there should be strong works on the heights, while the valley and its branch ravines should be protected by cross-fire from suitably sited trenches.

The 3rd Section, Syaochenzi to Kunduling, the chief features of which were the narrow salient spur on the western side and the water channel running along the front on its eastern side, should have trenches on the narrow spur to enfilade the approaches, and if time allowed a blinded caponier for machine guns, while the channel should be formed into a huge *point a'appui*, by (*a*) adapting it for defence, (*b*) connecting it with the works on its flanks by trenches, (*c*) protecting both channel and trenches with abattis, and (*d*) preparing for defence the native house in rear, to command the whole interior of the space thus enclosed. At the same time trenches should be placed along the crests of the hills in the centre.

The left section should be protected on the right by the strong and extensive *yimpan* (or enclosed farm), which when put in a state of defence would enfilade approaches, connect up with No. 3 Section, and

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close the valley at the mouth of which it stood. The left flank near the railway should be protected by a strong work, and the intermediate crests by trenches.

The position described in the above report intersected the railway at four miles to north of Kungchuling Station, and rested on the front slopes of a line of small hills lining the northern bank of the river Dalyao-ho. Belonging to the category of "Reserve Strategical-Rear" positions, it stood in the probable line of retirement of the Russian armies from their main position at Hsipingai. The right half-position took the form of a salient right angle, generally facing the probable line of advance of the enemy. Its extent—about 11¼ miles—might not be considered unsuitable for occupation by an army of five army corps, when it is remembered that the latter must previously have fought an unsuccessful battle in the Hsipingai position.

The ground was generally unsuitable for the action of cavalry, except on the extreme western flank, where it was flat and open and convenient for manœuvring large masses of horsemen.

As regards the fields of view and fire to be obtained from the position, there was considerable difference between the various sections. Near the railway the field of view, both near and far, and also the field of fire, were very good, the front-lying ground being level, and the only cover available to the enemy being the river gorge, which ran parallel to the front and about 1,200 yards to south of it. The right flank was drawn back in the project to some distance from the river, and the commanding height at the trigonometrical station, which was left unoccupied and stood at from one to two miles distance from the front, deprived it of both distant view and fire.

As to the flanks, the left was protected by the position of the 1st Army, beyond the railway. The right rested on no natural obstacle, but the country being open and flat, and the view unimpeded by anything except bushes which could be easily cleared, this flank when fortified might be considered sufficiently safe.

Communication within the position, along its front and in its depth, was impeded by many streams with swampy bottoms, which required a large number of small bridges and causeways.

As ready-made cover within the position, the Chinese villages were very suitable, being surrounded with mud walls, very convenient for defence.

There were no serious obstacles to the enemy's advance in front of the position, but as an obstacle to counter-attack from the left flank the river gorge may be mentioned.

The line of retreat was obstructed by a deep ravine which extended parallel to the whole front at between four and five miles in rear of it; this ravine was already crossed by four bridges, but this number was not thought sufficient, and it was decided to make more bridges and to improve existing fords.

The following is a detail of the work which was actually decided on and carried out in the position:—

Between the 26th and 31st May a detailed reconnaissance of the ground

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was made by the Inspector of Engineers, 2nd Army, and it was then decided to make the following alterations in the design:—

(1). To increase the depth of the position, especially that of the right wing, which seemed the most liable to attack, on account of the constant attempts made by the Japanese at enveloping and turning movements. With this object an advanced line was added in this part of the position, reinforced with fortified *yimpans* and redoubts of trench profile.

(2). To increase the number of *points d'appui* in the main line along the whole position, placing them in two rows, and thus giving each section separately the power of making a resolute defence.

(3). To make a separate front position on the commanding ground near the trigonometrical station, so as to prevent the enemy from approaching unseen to the right half of the position, and thus turning the right flank.

(4). To put some redoubts of strong profile behind the salient as an additional defence to the right flank.

(5). To carefully construct communications both along the front and in the depth of the position, and to add four bridges of piles to those already existing over the ravine in rear.

The troops detailed to carry out the defence works were the 99th Infantry (Ivangorod) Regiment, and the 160th Infantry (Abkhasia) Regiment, each of four battalions, and the 3rd Company, 16th Sapper Battalion. The general superintendence was entrusted to the writer of the article, Colonel Tsabel.

During the reconnaissance already mentioned, in the presence of the regimental and battalion commanders and of all the sapper officers, the sites of all redoubts were finally selected and the lines of rifle trenches laid down. The troops set to work clearing the foreground on the 1st June, and the siting of the trenches was checked and, if necessary, amended as this work proceeded.

The whole position was divided into two regimental sections, and each of the latter into battalion sections, each battalion being encamped within its own section. The sappers were divided between regiments and battalions, and were attached to the infantry for rations in order to relieve them entirely of routine duties.

Work proceeded daily from 7 a.m. to 11 a.m., and from 3 p.m. to 7 p.m. The work in the redoubts was superintended by the battalion commanders and directed by the sappers. The lines of rifle trenches were divided into company sections, in each of which the work was managed by the company commander under direction of a sapper officer. From each company a portion of the men, under a junior officer, was placed at the disposal of the battalion commander for work in the redoubts, while the remainder worked in the company section.

On the 10th June the 3rd Company of the Abkhasia Regiment, with a party of sapper carpenters, was detached to commence the bridges over the ravine in rear.

On the 8th July, in consequence of the heat, the G.O.C. 2nd Army reduced the working day to six hours, work proceeding from 6 a.m. to 10 a.m., and from 4 p.m. to 6 p.m. From this date also the Sunday

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holiday was introduced, and the bread ration was increased from 2¼ to 2¾ lbs.

On the 14th July the rainy season commenced; on the 18th July the G.O.C. 2nd Army inspected the position, and sanctioned the preparation of the front position at the trigonometrical station for six battalions and three batteries; on the 19th July occurred a serious storm, by which many trenches were filled up, casemates destroyed, and trestle bridges and causeways washed away.

On the 25th July the working day was further reduced to three hours only in the mornings, the afternoons being allotted to training. The Abkhasia Regiment did a course of musketry, which reduced the working parties by one-half, and the works made little progress, as the men available for work were hardly sufficient to repair the damage caused by the rains, which still continued.

After this there were rumours of peace, and the progress of the work became less and less, until it ceased entirely on the 3rd September.

The following is a more detailed description of the various kinds of work carried out on the position:—

Clearing the Foreground.

The foreground was cleared continuously in front of the main line for a distance of 2,000 paces, and in front of the redoubts of the second line for a distance of 800 paces. Shrubs and small trees, up to 3 inches in diameter, were removed, but of the larger trees, only those were cut down which were required for the roofs of splinter proofs in trenches and redoubts.

The many Chinese dwellings which impeded the field of fire were left untouched, to be demolished only when necessary, as the urgency of the case did not warrant the expense and unpopularity which would be incurred by evicting the inhabitants.

Rifle Trenches.

These were sited on suitable ridges in the front slopes of hills, or in level ground wherever they could find the best field of fire. The length of each trench—depending on the ground—varied from 25 to 200 paces. The profile was one which allowed of firing standing from a step. The parapet varied in height from 0 to 4½ feet, depending on the requirements of the field of fire and avoidance of dead ground. The total length of rifle trench made throughout the position was 26,700 paces. Traverses were made in the trenches at intervals of 15 to 20 paces.

Light splinter-proof cover was made under the front parapet, in length equal to one-quarter of the total length of the firing line. This allowed cover for one-half of the garrison, as the men sat in these blindages two deep. Each blindage was built to hold 25 men, a half-section.

In commanding points, possessing a wide field of fire, special blindage-hoods were made, to accommodate 12 men firing from underneath them.

The interior slopes of parapets, and the steps, were revetted with hurdle-work, sods, and kowliang stalks, the last-named form of revetment being especially suitable to low parapets.

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COMMUNICATION TRENCHES.

These were dug wherever the approaches to the rifle trenches from the rear were insufficiently concealed, and in some cases the rifle trenches were also connected together along the front in groups, the trenches of each company being as far as possible grouped in this way.

The profile of the communication trenches varied considerably in depth in different places, but in every case 6 feet of cover was provided. In plan the trenches represented either short zigzags, or were similar to siege approaches with traverses at intervals of 15 paces. Wherever a field of fire was obtainable they were provided with steps for riflemen. Their uniform breadth at the bottom was 2·35 feet, and all angles were rounded off to allow the passage of stretchers. At intervals wider crossing places were made in the trenches. The total length of communication trench constructed in the position was 14,245 paces.

POINTS D'APPUI.

These consisted either of Chinese *yimpans* prepared for defence, redoubts of trench profile, and redoubts of stronger profile with outside ditches. The *yimpans* were disturbed as little as possible on account of the inhabitants. The outside walls were loopholed, those which were too thin and those exposed to artillery fire being reinforced with earth. Flanking defence of the walls was prepared either from the towers or by special caponiers. In high walls the loopholes were placed at a height of 6 to 7 feet from the ground, with banquettes on the inside, and in places two tiers of fire were arranged, the platform for the upper tier forming a blindage for the protection of those below. Within the *yimpans* were built *shimoze*-proof blindages, and defensible exits were made in the back walls for communication with the rear.

The following work was left to be carried out at the last moment by the garrisons of the *yimpans*:—To clear the field of fire by demolishing orchards and outbuildings; to remove inflammable materials and provide means for extinguishing fires; and to barricade the gates and all superfluous openings in the walls. This work was estimated to take about three to four hours.

The *redoubts of trench profile* were placed in the firing line, and consisted of closed trenches, each accommodating two companies, surrounded by rings of obstacles. They are denoted in the plan by the letters A, B, C, D, E, F, G, and H. By order of the Commander-in-Chief all redoubts were provided with whisker-trenches. In each redoubt the whole garrison was provided with blindage cover, of which not less than one-quarter was *shimoze*-proof.

The *redoubts with outside ditches* (Nos. 6 and 7 in front line and Nos. 1, 2, 3, 4, 5, 8, 9, 10, 12, 13, and 14 in second line) were chiefly noticeable for the arrangements for the defence of their ditches. These were either frontal or flanking, the latter being provided by either open trenches or concealed caponiers. In each redoubt the whole garrison was provided with *shimoze*-proof shelter. Wells for drinking water were dug within

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most of the redoubts, and where this was not possible Chinese earthenware jars were placed in the blindages for storing water.

The inner slopes of parapets were revetted with hurdle-work, crowned with sods. Traverses were revetted with hurdle-work, sods, and *kowliang* stalks, and steps with hurdle-work. For obstructing the passages through obstacles, and approaches through the parapets to the whisker-trenches, *hedgehogs*, *i.e. chevaux de frise* entangled with barbed wire, were made to fit the openings.

Cover for Artillery.

The artillery commander of the 16th Army Corps was specially detailed to select the artillery positions, and during five days, from 10th to 14th June, in company with the officer superintending the works, he selected sites for gun emplacements for eight artillery brigades, assuming that the strength of the army would be four army corps, each containing two artillery brigades.

The positions chosen were concealed either on the reverse slopes of hills, or behind bushes or groves. Besides these, sites were selected in the firing line for some "Georgievsk" sections, intended for immediate action against attacking infantry.

It was decided by the G.O.C. 2nd Army, that the excavation of the gun emplacements should be deferred until the actual occupation of the position, for fear that the sites of the guns should be given away by Chinese spies.

As part of the defences of the front position—which was sanctioned after the inspection of the G.O.C. 2nd Army—emplacements were excavated for 48 guns, connected together in batteries by communication trenches.

Obstacles.

All the *points d'appui* were surrounded with obstacles, which consisted chiefly of five rows of *trous-de-loup*, reinforced with wire entanglement. Besides this, in all places peculiarly accessible to the enemy, were placed separate groups of obstacles barring covered approaches to the position. For instance, on the left flank, in the interval between redoubts G and H, and in front of bridge No. 24, the ravine running into the position was blocked with abattis and wire entanglement, and for commanding the obstacle the portion of the ravine immediately above it was cleared and two rifle trenches with blindages were built in it.

The *trous-de-loup* were all made 6 feet deep, and measured 6 feet wide at the top and 3 feet at the bottom. The clayey nature of the ground was very favourable to their use, as with this it was found that very steep excavations preserved their shape for a long period. In consequence of this the *trous-de-loup* were placed at a distance of only 1 foot from one another, or 7 feet from centre to centre, and presented a very serious obstacle to assault. In spite of frequent and abundant rain, they were still in good order when peace was concluded three months later.

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In conjunction with the *trous-de-loup*, entanglements of both plain and barbed wire were used, and also pointed stakes, the latter in the Redoubts E and F, as the supply of wire ran out.

Redoubt A was surrounded with a special portable abattis.

BRIDGES AND ROADS.

The communications within the position were carried out simultaneously with its fortification, and included mainly the construction and repair of bridges over the numerous streams and narrow ravines which intersected the position in various directions. Spans up to 17½ feet were bridged by frame bridges, and larger gaps by trestle and pile bridges. The roadway in every case was 14 feet wide.

Across the boggy valley and stream, between Redoubts D and No. 6, there were made, besides the bridges, three causeways with aggregate length of 2,100 paces.

In all 48 bridges of various sizes were made. No. 23 was 77 feet in length, supported on two shore abutments and nine piers, each consisting of two piles. Many small bridges were made over communication trenches, drainage cuts, etc., for the convenience of inspecting officers and others.

Of the four new bridges built over the ravine in rear, No. 3 (35 feet in length) was of trestles; No. 4 (70 feet in length) rested on four piers, each consisting of four piles; No. 5 (77 feet in length) was of piles; and No. 7 (154 feet in length) was also of piles. As a precaution in case of damage to any of these bridges a cross-road was made along the south side of the ravine, with three small bridges crossing branch nullahs.

The bridges, Nos. 3, 4, and 5, built before the storm of the 19th July, were all more or less damaged by it. No. 3 was washed completely away, but the others, although much damaged by the water rushing over them, both themselves and their shore abutments built of gabions anchored back with wire, remained intact.

STORM-WATER DRAINAGE.

Drainage arrangements were made during the construction of all the defences. In redoubts, with outside ditches, the drainage from the interior was led into the ditches, while redoubts of trench profile, trenches and communications, were drained into soak pits, or if the ground was favourable, by drainage channels.

During May and June the works suffered little from the weather, but during July the rainy season began, and the water came down in such quantities that everywhere great destruction was caused to all the works. During the storm of the 19th July all the streams overflowed their banks, and a flood from the hills washed over works and trenches, completely filling many of them with silt.

The works in the water channel in front of Redoubt No. 8 were completely destroyed, and in the redoubts, without side ditches, the caponiers were flooded with water, which ran in through the loopholes. As a result of the flood brushwood revetments soon began to rot and parapets to collapse. After this for some time new work had to be abandoned,

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and all hands set to work to repair the old works, and to protect them from further damage. Meanwhile the rains continued, and on many days it was not possible to do any work.

It is most important before commencing a work to consider the question of drainage from all points of view, and further, to make ample drainage arrangements during the construction of the work itself.

CONCEALMENT.

The following measures were taken to make the defences as inconspicuous as possible:—The height of parapets was reduced as much as the requirements of a good field of fire without dead angles would allow; all outside angles were rounded; the interior parts of works were not allowed to show above the firing line; obstacles were placed in triangular ditches, and concealed from the front by glacis; and in front of the trenches the nearer bushes and trees were not cut down continuously, but only so far thinned as not to impede the fields of fire and view over the front-lying ground. A rapidly-growing weed was sown over all the works, and quickly rendered them invisible.

CONCLUSION.

In most "Reserve, rear" positions, it is considered sufficient to content oneself with making the redoubts and excavating some of the main approaches, *i.e.*, only such works as would take much time in their construction. To dig the rifle and communication trenches in these positions is inadvisable, partly because—if they have to stand many months before their possible use—they would have to be made unnecessarily solid, and partly because they could always be easily excavated by their future garrisons in the course of a few hours. Where many reserve positions may be necessary, considerations of economy would naturally limit the work done to that alone which is absolutely necessary.

But in the Kungchuling position, it was decided to make both works and trenches, and also to commence both simultaneously. The reason for this was its very insignificant distance in rear of the main Hsipingai position, which, in view of an unsuccessful battle and a retirement of the Russians from that place under pressure from the enemy, might not allow the troops leisure for even hasty entrenchments. That works and trenches were carried out simultaneously, even with the limited amount of labour available, was due to the uncertainty of the conditions as to the time available, as this necessitated the carrying out of the work so as to be in constant readiness for a possible attack. The order of work was consequently arranged as follows:—First of all the Redoubts Nos. 6 and 7, A, B, C, D, E, F, G, and H, and the trenches of the front line were commenced, and only when this work had made good progress, were the redoubts of the second line begun at a distance of 700 to 1,000 paces to the rear. At the same time the first—and main—line of defence was continually improved by putting native houses in a state of defence, constructing obstacles, and excavating a complete system of approaches communicating with the ground in rear.

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The writer did not approve of the line taken up for the position. Its form, a salient right-angle, would give the enemy the power of sweeping one or other side with oblique or enfilade fire from guns in his rear. The right half of the position lay in low and very inconvenient ground; in front, at a distance of 2,500 to 3,000 yards, stood commanding ground, and in rear the ground also rose, exposing the communications. If, possibly from the objection to advancing the position too far forward with reference to the adjoining position of the 1st Army, it was decided to abandon the commanding ground at the trigonometrical station, then the right half of the position should have been drawn back, so that the whole position might present a straight line perpendicular to the enemy's probable line of advance, and out of artillery range from the trigonometrical station hill. This arrangement, while not interfering with the good position of the left half, or with its communication with the 1st Army, was additionally desirable, as it would have brought the line nearer to the watershed, and would have considerably improved the field of fire.

The result of this faulty choice of the line of defence was the necessity of the front position, and also of a rear position, in rear of the right flank on the above-mentioned watershed, though the latter, through want of labour and time, was never made.

Frequent errors made in the selection of defensive positions during the war arose from two causes:—(1) That sufficient time was not allowed to those drawing up the project of defence to carry out this important duty thoroughly, and (2) that, owing to the non-existence of a contoured survey of the country, and to the fact that surveyors sent to draw the ground often contented themselves with sketching only the area actually included within the position, those whose duty it was to criticize the projects were unable to form any opinions as to the approaches, flanks, or ground immediately in rear of the proposed position. The hastily-prepared projects were passed practically without criticism, and the works had frequently made considerable progress before defects received official notice and necessary alterations were authorized.

F. E. G. SKEY.

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REVIEW.

A FRENCH MANUAL OF FIELD FORTIFICATION.

Instruction Pratique sur les Travaux de Campagne à l'Usage des Troupes d'Infanterie, 1907, is a slim volume of 70 pages, about 7″ × 3″ in size, easy to slip into the pocket.

The preface contains the significant warning to soldiers that although recent wars have shown the necessity for the frequent use of fortifications on the field of battle, yet "it must not be lost sight of that the protection to be sought against projectiles must in no case be allowed to diminish the offensive spirit of our infantry, nor to interfere with its aptitude for movement." . . . "The fact that works have been executed must never keep troops at a particular spot, if the situation at the moment requires their presence elsewhere."

The first chapter deals with general principles; field fortification is divided into hasty (*legère*) and strengthened (*renforcée*); "the former only is of interest to the infantry," and includes utilization of cover and obstacles, formation of parapets, trenches, organization of a position, construction of communications, and demolitions. Field fortification is said to be of special use to advanced guards, and when breaking off a combat. Trenches on the field of battle must generally be excavated lying down.

Differing altogether from the German manual, which lays down as a principle that on the defence one line only is to be prepared, the French instructions direct that successive lines of resistance shall be constructed, although they do not go so far as to label them, *à la Russe*, "advanced," "intermediate," "main," and "rear" positions. They also lay great stress on the use of obstacles, and direct their use at all points which the defender must retain *à tout prix*. Finally they recommend the construction of entrenchments to cover the troops detailed to make the counter-attack, unless natural cover is available.

Chapter II. shows how existing cover—ditches, banks, hedges, walls, etc.—can be utilized, and describes by diagram how to dig lying down. The soldier lies at full length on his stomach, with his head on his left arm, and scoops an ellipse-shaped hole, length about the distance of his head to the middle of his thigh, under his right side. As soon as he can, he gets his chest into the hole; no trench is made for the legs.

In carrying out the organization of an extended line it is stated:—"In principle, the different infantry units, either with their portable tools or tools obtained from the engineer park, will construct the entrenchments of weak profile which they are charged to defend, and will organize the cover or obstacles which they are called on to occupy.

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The engineer troops attached to them will, in principle, execute the entrenchments of strong profile, will construct shelters, establish accessory defences, organize redoubts, create points of passage through obstacles, improve communications, carry out important demolitions, and, in general, all the works which require special technical knowledge." As regards the choice of a position and the design of the trenches, the manual lays down:—"The details of the works will be decided on during the reconnaissance made by the commander of the infantry which is charged with the defence." . . . "He alone is responsible for the choice of the line to be occupied and the distribution of the defenders."

Chapter III. deals with practical instruction which is divided into individual instruction, squad instruction, and cadre instruction. It is laid down that:—"It is necessary to train the soldier by constant practice in the handling and use of tools." Individual instruction is limited to the value and use of cover, improvement of cover, formation of parapets. Squad instruction deals with the combination of the work of several soldiers, clearing a field of fire, light bridging, making abattis, making passages through woods, improving the cover of walls, palings, etc.

Cadre instruction is given to officers and N.C.O.'s, and includes putting a position into a state of defence, tracing, arrangement of working parties, reconnaissance of routes, use of explosives, simple demolitions, passage of ditches and water courses.

The instruction of officers is completed at the "schools of field fortification," when all infantry subalterns are attached to engineer battalions for six weeks.

The last 30 pages of the manual contain annexes.

Annex I. gives the portable tools carried by an infantry company:—

112 spades (which have rounded, not tee, heads), 32 picks, 12 hatchets, 4 axes, 16 billhooks (*serpes*), 4 chisels, 1 jointed saw.

Annex II. gives examples of the profiles of fire trenches—for "sitting," kneeling, and standing. In the "sitting" position (which is peculiar) the front part of the trench is 20 c.m. (7·8 inches) deep and 40 c.m. (15·7 inches) wide, and the rear portion is of the same width, but 60 c.m (23·6 inches) deep; the left knee rests on the step thus formed, while the right leg is extended into the deeper part of the trench. The parapet is 60 c.m. (23·6 inches) high.

In the kneeling position the soldier kneels on both knees in a trench, improved from the "sitting" pattern by deepening the trench to 60 c.m. (23·6 inches) all over. The parapet is lowered to 40 c.m. (15·7 inches) and proportionately thickened.

The kneeling trench is improved for standing (1) by deepening it 20 c.m. (7·8 inches), and (2) by widening it 30 c.m. (11·8 inches). By deepening this new width 40 c.m. (15·7 inches) a man can sit comfortably, sheltered by the parapet. Elbow rests are not provided in these patterns, but are exhibited in a separate drawing; grooves for the rifle to rest in are always made.

The French troops work in parties (*ateliers*) of four or five men, furnished with three or four spades and one pick; each party is expected to execute 75 c.m. (2·46 feet) of trench per man.

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Short paragraphs only are devoted to concealment of parapet and overhead cover; head cover is not referred to.

Annex III., Part I., deals with demolitions. The French demolition charge (*pétard de mélinite*) is 135 grammes (4·73 oz.) of melinite contained in a brass case, about 4″ × 1″ × ⅔″, the whole weighing 200 grammes (7 oz.). The cover is secured by a soldered band; when this is removed a socket in the head of the charge is exposed; into this a cap, containing fulminate of mercury, can be placed. Instantaneous fuze (*cordeau détonant*) and safety fuze (*cordeau Bickford*) are provided.

Simple instructions for the demolition of walls, trees, railways, abattis, wire entanglement, railway lines, telegraph lines, and ice are given. It is stated that a charge made up three petards thick, and of a length equal to the depth of the obstacle, will clear a gap in wire entanglement from 3 mètres to 6 mètres wide (9·8 feet to 19·6 feet), according to the character of the entanglement. Each infantry regiment, or independent battalion, carries 108 petards.

Annex III., Part II., gives some short directions for the passage of streams by extemporized means, boats, fording, and on ice.

Annex III., Part III., deals with very elementary camping conveniences:—A kitchen "is formed of two or four stones, on which the pots rest. In the absence of stones, dig a simple trench." The latrine is a long trench with "the earth from it thrown right and left, so that the man can place his feet on each side of the excavation," and thus squats astride of it.

The very short and simple instructions given in this volume, taken in conjunction with those contained in the *Règlement sur les Manœuvres* and the *Règlement sur l'Instruction du Tir*, of which they are the complement, seem to indicate that the French military authorities have not been carried away by the experiences made in the special circumstances of the Russo-Japanese War in Manchuria, and do not intend to break the *élan* of the French infantry by over-indulgence in spade-work.

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NOTICES OF MAGAZINES.

Building News.

The number of June 12th, has a report on Dry Rot, from which the following notes are extracted :—

1. *Definition.*—Dry rot is a state of decomposition in wood caused by dry-rot fungi—the commonest of which is *Merulius Lachrymans.*

2. *Favourable Conditions to the Generation of Dry Rot.*—The spores of *Merulius Lachrymans* require the presence of an alkali such as ammonia, and it is found in cellars, stables, and outhouses where ammoniacal or alkaline emanations can reach the timber.

It has been popularly supposed that timber felled in summer was more prone to dry rot than timber felled in winter. This has been proved to be incorrect; dry rot will attack timber independently of its quality.

3. The dark stagnant air in cellars and under boarded floors of the ground storey is very congenial to fungus growth.

4. The principal parts of buildings in which it is found are :—

Warm cellars, unventilated floors, basements; particularly in kitchens or rooms where there are constant fires.

The ends of timbers built into walls are nearly sure to be affected by dry rot unless they are protected by iron shoes, lead, or zinc. The same result is produced by fixing joinery and other woodwork to walls before they are dry. Linoleum, kamptulicon, and other floor cloths, by preventing access of air and retaining dampness, cause decay to the boards they cover.

5. *Prevention of Dry Rot.*—All brickwork and concrete floors must be thoroughly dry before timber is placed in contact with them.

6. Any substance or device which imprisons moisture within wood, or prevents free evaporation from its surface, or maintains a damp atmosphere in its neighbourhood will develop dry rot.

Unventilated floors must not be covered with an impervious covering.

Damp or ill-seasoned wood must not be painted, tarred, or covered with plaster of paris; ordinary plaster is sufficiently porous to be safe.

7. Cellars and floors must be properly ventilated.

8. Any specification for the construction of a wooden floor should provide for the removal of all chips, shavings, etc., as these are a fruitful source of dry rot.

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9. The ends of beams and joists if built into the wall must have an air space round them, or if this is impossible, should be protected with iron shoes, lead, zinc, or creosote.

10. *Methods of Eradicating Dry Rot.*—Every trace of the fungus should be scraped from the timber, brickwork, or wherever it is found, and the surface of the soil, if exposed, should be removed; the whole must then be burnt. If timber is too far gone for this treatment it should be cut out and burnt.

11. If this cannot be done the beams should be soaked with corrosive sublimate dissolved in methyl alcohol. Methyl alcohol has great penetrating power, and acts as a vehicle to carry the corrosive sublimate into the texture of the wood. The inflammable nature of methyl alcohol must not be forgotten.

12. Carbolic acid or a strong solution of copper sulphate (blue vitriol) in boiling water may be substituted.

13. The walls and concrete floor, if any, should be washed with carbolic or sulphuric acid or Condy's fluid, and the air should be disinfected by burning sulphur.

14. In a slight attack the wood may be covered by a hot limewash.

15. These remedies, however, do not penetrate very far, and as only those parts of the fungus are killed which are in contact with the poison, the deeper-seated hyphæ may remain as active as ever. The rot is not stayed, but its ravages are hidden from view.

R. N. HARVEY.

MEMORIAL DE INGENIEROS.

On the occasion of the hundredth anniversary of the outbreak of the War of Independence, known in England as the Peninsular War, the editor of the *Memorial de Ingenieros* has produced an exceedingly handsome volume of 200 pages, profusely illustrated, dealing with the organization and services of the Corps of Engineers during those campaigns. The various chapters have been written by distinguished officers of the Corps, and the work is a mine of information, specially interesting to British officers.

The Spanish engineer troops date back from the commencement of the last century—the Royal Regiment of Sappers and Miners having been created by a decree dated 5th September, 1802, whilst the Engineer Academy was inaugurated on the 1st September, 1803.

In 1808 there were 196 officers belonging to the corps, of whom 60 were doing duty with engineer units, and the remainder were employed on division work. The regiment of sappers and miners consisted of 2 battalions, each containing 5 companies—1 of miners and 4 of sappers. Each company was commanded by a 1st captain with 4 other officers, 5 sergeants, 16 corporals, 2 drummers, 104 sappers and miners. The

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staff of the 1st Battalion consisted of 1 colonel, 1 second in command, 2 adjutants, 1 ensign, 1 chaplain, 1 surgeon, 1 armourer, 1 drum-major, and 2 fifes. The staff of the 2nd Battalion was similar, except that the commanding officer was a lieut.-colonel. The total strength of the regiment was 1,215 of all ranks.

At the opening of hostilities the headquarters of the regiment were at Alcalá de Henares, near Madrid, and companies were stationed besides in Portugal, in Minorca, Badajoz, Cadiz, Ceuta, and the Campo de Gibraltar. Steps were at once taken to raise fresh battalions and companies, and by 1811 there were 6 battalions, with an establishment of 3,018 men.

The war commenced by the revolt of the troops in Madrid on the 2nd May, 1808. This revolt was put down by Murat with great severity, but on the 24th of the same month the two sapper companies stationed in Alcalá, marched out of that town, in order to escape from being compelled to take the oath of allegiance to the French Government, and reached Valencia on the 7th June, where they joined the National Government, proclaimed a few days earlier by the Count de Castellon. The engineers took a leading part in the second siege of Zaragoza, the third siege of Gerona, at Ciudad Rodrigo, Badajoz, Burgos, Monzón, etc.

The work contains chapters on fortification and siege works at the time of the war, and on bridges. It also has a list of the services of the principal engineer officers, and of the losses sustained during the campaigns.

'M.'

NATURE.

January to May, 1908.

LIFE ON MARS (p. 442).—One of the most telling arguments which have been used against the possibility of the planet Mars being habitable, has been that spectroscopists have failed to detect the presence of water vapour in the planet's atmosphere; but in March, 1908 (p. 606), Mr. Slipher—in Arizona—succeeded in photographing the lines due to water vapour in its atmosphere. The detection was rendered possible by the use of plates specially prepared by him for the purpose, which enabled the spectrum to be photographed somewhat beyond the "A" band. Comparative spectrograms were made of the moon at approximately the same altitude on the same plates, and with exposures to give a like density for both. Repeated plates of this sort were taken, and their concensus shows unmistakably the "A" band stronger in the spectra of the planet, than in those of the moon. In the case of the moon we are looking through our own atmosphere only; in the case of Mars, through its atmosphere as well. The great dryness of Arizona was a factor in the result. So dry was the air at times during the investigation, that on more than one plate the "A" band is hardly to be made out in the lunar

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spectra, while in the Martian it is unmistakable. The presence of water vapour in the spectrum of Mars is strong presumptive evidence that free oxygen exists in its atmosphere as well, since it is the heavier of the two.

On the series of photographs (p. 182) obtained on 25th July, are to be seen delicate canaliform markings, which entirely refute the suggestions that such markings, previously recorded visually, are merely subjective phenomena. Professor Lowell thinks that these are really canals made by sentient beings, while Professor Pickering suggests that they are—like the rifts and streaks on the moon (p. 338)—caused by volcanic action, due to internal stresses set up by the cooling of the planet's heated interior. The melting polar caps, and their reforming, affirm the presence of water vapour in the atmosphere, and Professor Lowell has observed blue borders on the edges of the polar caps as they melted. Dr. Wallace disagrees with this interpretation of the caps being frozen water, pointing out that for water to be blue it must be deep, and this cannot be so on Mars, because its surface is so level, probably not more than 2 feet. Dr. Stoney has stated that aqueous vapour cannot exist permanently on Mars, or on any planet, unless its mass is at least a quarter of the earth. As the mass of Mars is only one-ninth that of our earth, the planet must have parted with its vapour ages ago, because the velocity of the molecules would be too great for the attraction of the planet to retain them. Dr. Stoney does not state the temperature he has assumed in this calculation, but a dozen miles above the surface of the planet the temperature of its atmosphere must approach absolute zero—a condition of things in which even hydrogen (p. 302) would not have the necessary velocity to escape.

In certain seasons a blue-green colour on Mars has been noticed, and this Professor Lowell attributes to vegetation, and its change to chocolate-brown, to the fading of verdure with the change of the season.

It is now a commonplace (p. 413) of geology, that a variation of the small percentage of carbonic acid in the earth's atmosphere will have an important effect on the temperature of the latter. A relatively large amount of carbonic acid will cause a correspondingly greater proportion of the heat received to be retained, and the temperature will be higher. Such conditions will be marked by luxuriant vegetation. If now we make the very reasonable assumption that the crust of Mars is composed of the same minerals as those with which we are familiar, and its atmosphere of the same gases as ours, and that accessions of carbonic acid are received from the interior of the planet, we may expect a similar automatic adjustment of the temperature, so that it is never too cold for vegetation, such as that believed by Professor Lowell to maintain itself somewhere on the surface of the planet. Whether Professor Lowell can be considered to have established his views is doubtful, but the arguments against them are not convincing, and remind us of those of the engineers who satisfied themselves that a locomotive could not draw a train of trucks on smooth rails, and were not persuaded to the contrary until they saw that it did so!

W. E. WARRAND.

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REVISTA DE ENGENHERIA MILITAR.

May, 1908.

THE CENTENARY OF THE PENINSULAR WAR.—The *Revista Militar* proposes to commemorate the centenary of the Peninsular War by publishing during the years 1908—1914 articles relative to the events that occurred during its campaigns, and the editor is consequently asking for the assistance of all those who may possess documents or information bearing on the subject.

This centenary is being celebrated with much enthusiasm in Spain and Portugal, and as the Peninsular War equally secured our national independence, this display of patriotism might well appeal to Englishmen.

The particular subjects on which the editor of the *Revista Militar* is seeking for information are :—

1. Military psychological study of the Portuguese Army at the commencement of 1807 (discipline, military justice, education; dominant ideas regarding strategy and tactics; respect for tradition, etc., etc.).
2. Ditto after the war.
3. Comparative study of the Portuguese Army from the point of view of its worth as an organ of defence in 1807 and 1814.
4. Portuguese generals; their influence on the campaign.
5. Portuguese officers; their recruitment and degree of general and professional training in each of the arms of the service.
6. Foreign officers; their influence on the reorganization of the Portuguese Army; their relations with Portuguese officers.
7. Biographical studies of distinguished officers both foreign and Portuguese.
8. Proofs of resistance given by the Portuguese soldiers during the war (age, physical vigour of the men, districts traversed by them, seasons of the year, etc., etc.).
9. Parallel between Beresford and Lippe from the point of view of the influence which each of them exercised on the Portuguese Army.
10. Criticism of the plan of campaign which the Portuguese generals proposed to follow before the English generals took over the conduct of the war.
11. Plan of campaign of the English generals and its justification.
12. Appreciation of the two plans above referred to.
13. Recruitment and means employed for completing the effectives of the Portuguese Army during the war.
14. Training of the recruits during the war; means employed of effecting it.
15. The Portuguese infantry; its organization and services rendered by it during the war.
16. The Portuguese cavalry; its organization and services rendered by it during the war.
17. Portuguese cavalry remounts during the war; quality of the horses proved by examples drawn from the history of the war.

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18. The Portuguese field artillery; its creation and organization; armament; part played by it in the war.

19. The Portuguese siege and garrison artillery; ditto; ditto.

20. The Portuguese military engineers; services rendered by them in the war.

21. Militia; legal organization and real value at the commencement of the war.

22. Militia; services rendered by these troops during the war.

23. Militia trained bands (*ordenanças*); legal organization and real value at the commencement of the war.

24. Militia trained bands; services rendered by them during the war.

25. Is there anything in the organization of the militia and militia trained bands that would be advantageously applied at the present time?

26. Intrinsic value of the various works of permanent fortification of the country at the commencement of the Peninsular War.

27. Lines of Torres Vedras; their actual value.

28. Employment of field fortification by the allied forces during the war.

29. Sanitary services.

30. Supply of food to the allied troops during the war, more particularly within the frontiers of Portugal.

31. Method of supplying boots and equipment to the allied armies during the war, especially whilst in Portugal.

32. Supply of forage.

33. Supply of ammunition.

34. The arsenal of the army; its services during the war.

35. Lines of communication, both by land and river, made use of for the transport of ammunition and supplies, especially the Tagus and Douro.

36. Nature of the arms used during the war, and ranges at which they were effective.

37. Comparative study between the tactical value at the present time and at the time of the war of the positions occupied by the belligerents within the Portuguese frontiers, keeping in view the changes in armament.

38. Constitution of the English units which took part in the campaign with the Portuguese troops.

39. Expenses incurred by the Portuguese Army during the war.

40. State of the Portuguese Navy in 1807.

41. Units of the navy and their distribution at the outbreak of the war.

42. Services rendered by the Portuguese Navy during the war.

43. Bibliographical notice of unedited manuscripts on the war, and impressions of recognized rarity, not registered in the various dictionaries.

The editor also asks for sketches, portraits, caricatures, views of battles, itineraries, plans of fortifications, etc., bearing on the war.

HARMONIC SYNTHESIS OF THE TIDES (*continued from the April number*).—Determination of the levels of high and low water conjointly with the respective hours of their occurrence.

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PRESENT-DAY DIRIGIBLE BALLOONS AND FIELD AEROSTATIC PARKS (*continued from the January number*).—This article contains a description of the Nulli Secundus and the Italia, and a comparison of the systems employed in these two dirigibles and in the Parseval and Patrie. There is also an account of the Gordon-Bennett race from St. Louis and of the experiments of the brothers Wright.

Other countries, besides the owners of the balloons named in the preceding paragraph, are making experiments in aerial navigation. In Russia a committee has been assembled under General Kirvichiev to study the problem. In Austria-Hungary three airships are under trial, but details are not forthcoming. In Spain one is being built after the designs of Capt. Kindelan. It is to be 35 m. long by 6 m. in diameter, there will be screw propellers at each end of the car, and a movable weight is provided to correct longitudinal instability. When completed it will serve as a model for the construction of a larger machine.

SOME PROJECTS AND WORKS EXECUTED IN THE PROVINCE OF MOÇAMBIQUE IN THE LAST NINE YEARS (*continued from the April number*).—An interesting paper showing designs of works—some of them executed and some only projected. English and German practice in Africa is quoted with approval. Notes are given on the provision of lightning conductors, disposal of sewage, construction of kitchens, best system of construction to resist white ants, etc., etc. For the latter purpose the author recommends concrete walls in preference to brick, double channel iron floor girders, concrete or armoured concrete floors, roofing of papier maché or fibre-cement, door and window frames of mucurusse wood, which is abundant in Moçambique, and is not touched by white ants.

'M.'

RIVISTA DI ARTIGLIERIA E GENIO.

April, 1908.

REVIEW OF BOOKS AND PERIODICALS.—*Historical Sources of Military Architecture.*—Henry Rocchi (Major-General).—Under the above title General Rocchi has lately published a new work which is worthy of the highest admiration, because it seems scarcely possible to have comprised in so small a bulk so much learning and information.

In 500 pages, General Rocchi has recounted the entire history of fortification up to the last Russian and Japanese War. He had already published several works; among which may be mentioned a copiously annotated translation of Leithner's *Permanent Fortification and Fortress Warfare*—a work on the study of field fortification and another on the study of permanent fortification (three editions)—both of which are complete treatises on these branches of fortification; and finally numerous articles in the *Rivista di Artiglieria e Genio*, and in the *Rivista Militare*

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Italiana, which together form a library of military science, archæology, and art.

The author commences by a study of the conditions under which primitive men sought to defend themselves from the attacks of other men, caused either by envy, or by a desire to obtain possession of their wives and property. Taking refuge in caves, naturally difficult of access, they rendered the approach more difficult by obstacles at the entrances, or by erecting their dwellings on piles near the banks of lakes and rivers; they communicated with them by bridges, which they were able to dismantle or destroy, and thus became the originators of primitive fortification.

Passing from single individuals to the community, then to the tribe, and then to the State, these in their turn had recourse to similar artifices to those above stated, but of a more extended and important nature. They constructed fortifications of a simple and rugged kind, but which were sufficient for the exigencies of the time.

After referring to the art of fortification of early times, the author studies the art of Egypt, of Assyria, of the Greeks and Romans—as it can now be traced in the remains of the beautiful walls of Babylon—of Nineveh, Carthage, Thebes, Rome, and Pompeii.

The Greeks and Romans were well skilled in adapting the fortifications to the ground, and though this principle has been imposed upon all ages, it was, in a measure, forgotten by the scholars of the XVIIIth and XIXth centuries. Now of course its great importance is fully recognized by military engineers.

General Rocchi gives an excellent account of the first examples of active defences, where he speaks of the sieges of Rodi, Avaricum, Alessia, Syracuse, and Rome, and most interesting researches on the first use of the mine and countermine, on the first employment of explosives, Greek fire, and ballistic artillery.

The author examines with brilliant criticism the accounts of the arms that were employed for the attack of ancient works, and of those used for the defence, and reasons on the form of fortifications that should be adopted owing to modifications in the arms. He describes the many details of fortified works; the platforms, towers for observation, flanking towers, the ditches, ravelins, etc., and he deduces that the one great principle of the art of fortification is to know how to adapt and modify it, in accordance with the progress and modifications in the weapons of war.

In the middle ages of feudalism the art of fortification underwent a great change, owing to the breaking up of the States, and the great works of Greece and Rome gave way to mediæval castles in enormous quantities; in France in the XIth and XIIth centuries the numbers are stated to have been not less than 60,000. But in the XIVth and XVth centuries an event occurred of great importance in the history of military art, and not only was this importance limited to the military art, but also it played a great part in the constitution of States and their policy. This was the invention of firearms, which at first from modest beginnings increased step by step, abolishing entirely the ancient ballistic artillery,

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and substituting muskets, pistols, or other kinds of firearms, for the weapons of other days.

The art of fortification was greatly influenced by this new invention, and sought to adapt itself to the new order of things, by radical changes in the form and tracing of the earthworks. There was then the transition stage with an increased thickness of walls, a lowering of the towers, and abolition of small defences which became targets to the attackers and sources of danger to the defenders; then came the later epoch of fortification which led to the bastion tracing—the glory of the Italian engineers.

In Rocchi's work the appearance of firearms, their development and the results to the art of fortification, are fully explained, with dates and extensive notes. Interesting descriptions are given of the walls of Gradara, of Pesaro, Brescia, Forli, Como, and Viterbo; and also of those of Bologna, Camerino, and Alba, which combined ancient with modern methods.

The author describes, with learned analysis, the natural derivation of the modern bastion from the ancient tower by the slow influence of firearms, and he enumerates the names of many distinguished Italian engineers. Nor does he forget to mention the names of many illustrious foreign engineers, among whom may be enumerated the names of Vauban, Cormontaigne, Chasseloup, Dufour, Coëhorn, and many others.

The XIXth century presents a new era in the employment and construction of artillery with curved fire, breech-loading cannon, and powerful explosives. Again fortification has had to transform its methods of trace and profile, and to pass to the methods of casemates and armoured works. The changes are slow, methodical, and progressive, because the adoption of new forms is always confronted by the watchful upholders of tradition; and, it may be added, because alterations are always confronted by great technical and financial difficulties.

A great writer (De Christoforis) observes, speaking of fortification, that it is liable to become a slave to geometry and to system, and that one cannot say that it is completely free from the impediment of scholastic doctrine.

General Rocchi has said that to write a general history of fortification the author should be an archæologist, an architect, and a military engineer at the same time, and it may be added that he should also be an artist. The author possesses these qualities in a great measure, and has written an excellent work, with illustrations interspersed through the pages, forming a useful, indispensable, and delightful volume.

A STABILITY-INDICATOR FOR SMOKELESS POWDER.—At the sitting of the French Senate, held on the 30th of November last, to discuss the conclusions arrived at by the Commission of Inquiry into the causes which produced the disaster to the cruiser *Jena*, the Senator Monis—reporter to the said Commission—quoted in support of his subject an article published in the *Rivista Marittima* of January, 1908, viz., a letter of E. Bravatta, captain of frigate, on the stability of nitric cellulose and of smokeless powder. The writer especially insisted on the absolute

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necessity of introducing a *stability-indicator* for smokeless powder, that is, a substance which, whilst having the effect of preventing or at least of retarding the decomposition of the powder, changes its colour. By this means a simple ocular inspection may show whether the powder is in good condition or not, and whether it should be kept or destroyed.

Such a substance, which is made by a primitive formula from aniline, is said to have been studied and adopted in Germany, and by this means it would seem to have avoided the accidents and mishaps which other countries have had to lament.

During his discourse Monsieur Monis stated that about nine years ago the French Metropolitan Artillery proposed the employment of the German stability-indicator, but that the "Service for explosives" obstinately refused its adoption, and only desisted from its tenacious refusal after the *Jena* disaster. In fact in June, 1907, the stability-indicator was adopted unanimously.

The stability-indicator used in Germany, and now adopted in France, is the difenilamina, which is a secondary base of ammonia in the formula C_{12} H_{11} N. By distillation, azure of rosaniline is obtained, and it is produced by heating up to 250°, chloride of aniline and aniline. The difenilamina shows under the form of white crystals, which melt at 45°; boil at 310°, emitting an odour like that of roses, which is poisonous and of an acrid taste, and with vapour producing coughing. It is insoluble in water, and dissolves easily in alcohol, ether, petroleum, and benzine.

The salt acid, in contact with the air, is of blue colour. A solution of defenilamina in sulphuric acid, assumes an intense blue colour in the presence of even small traces of nitric acid, and consequently difenilamina constitutes a very sensible reagent to nitrous vapour.

Difenilamina is used in commerce for colouring matter, to obtain blue difenilamina, orange difenilamina, etc.; other colouring groups have a great affinity for difenilamina, and are therefore comprised under the name of difenilamina colours.

It thus appears that the stability-indicator used in Germany—and now adopted in France—is a substance which is used in commerce, and which is prepared without difficulty. The question of the stability and security of smokeless powder is of grave importance, although possibly it can be solved by a simple and modest method.

May, 1908.

REVIEW OF BOOKS AND PERIODICALS.—Ermano Albasini Scrosati, Member of Parliament.—*The National Defences.*—I. Our Naval Problem.—Commencing with a preface in which he states the motives which have induced him to write this book, the author examines the data on which the naval estimates were framed, and also the reasons for the continued increase of the same, and for a further increased allotment of 13 millions of lire. Contrasting our naval forces with those of other nations from data given in Lord Brassey's *Naval Annual*, the author arrives at the conclusion that the Italian fleet is inferior to all the other principal fleets,

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with the exception of Austro-Hungary; and considering the prevailing tendency of other states, he thinks that—notwithstanding the increase of 10 millions now demanded from the Government for the ordinary expenses of the navy—such inferiority is not destined to disappear. He next passes to an examination of the dangers of naval attacks, such as disembarkations, bombardments, blockades, etc. With regard to the first of these, the author, after an exhaustive discussion, is convinced that a landing on our coasts of more than 50,000 enemy's troops need not be feared; that the operation of disembarking on a beach is always dangerous, and that in Italy such an operation could only be attempted in a few localities which are perfectly known.

Secondly, with regard to bombardments, it is beyond discussion that with the powerful new guns the battleships are able to bombard maritime places at distances exceeding 10 kilomètres. The writer asserts that such bombardments would not have grave consequences and ought not to induce excessive alarm; that the latest war confirms this opinion. A bombardment may be confronted with tolerable serenity, but it is necessary to prepare for it beforehand by endeavouring to quiet the inhabitants, and by taking every precaution for reducing the losses to the least proportions, and for the ready extinction of fires.

The author shows the impossibility of extending a blockade to the whole of the Italian coasts, and points out that, in a country like Italy with three land frontiers, although there might be losses from the enemy's cruisers, the sufferings of famine and the danger to the internal industries of the country would not be encompassed by a naval blockade.

Signor Scrosati next considers what measures both defensive and offensive should be carried out for the navy. The submarine mine, the torpedo, and the submarine flotilla are the weapons of defence. The Russo-Japanese war has shown the terribly destructive nature of the first; and considering its surprising efficacy, all the navy, and especially the weaker units, should be prepared for a greater use of it in future wars. Not only would it be used for defensive measures, such as impeding the enemy's ships on our own coasts, but also offensively, by making it impossible or most hazardous for a hostile fleet to leave the ports of its own country.

The submarines, although their construction has not as yet been perfected, are peculiarly adapted for a nation which has not the means of creating a great navy, and which has to defend a long coast line accessible to the enemy's enterprises. This of course applies to Italy, and it is evident that in the organization of naval forces the submarines would be of the first importance.

The principal strategic value of these is that they assist the fleet by limiting the enemy's coast enterprises. The blockading of ports, and the bombardment of fortified places are operations not likely to be successful when submarines form part of the defences. The Italian submarines in the manœuvres of 1906 gave excellent results.

In conclusion, writes the author, the submarine mine, the torpedo, and the submarine constitute the most efficacious defence for a coast like that of Italy.

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The views of the Hon. Albasini Scrosati, however, are not in accordance with those of the editor of the *Rivista*, who, while acknowledging the lucid theories of the author's important work, is of opinion that an eminently naval nation like Italy has a far higher mission than that of being assigned to a mere passive defence.

MILITARY AUTOMOBILE PLOUGH.—The *Revue d'Infanterie* of the 15th April reports that an engineer has lately constructed an apparatus called a *military automobile plough*, designed for rapidly excavating trenches for infantry.

The automobile plough consists of a wagon with two parts, (1) a front limber, similar to that used for field artillery, in which the box contains only the tools required for repairs, and changeable pieces; and (2) a back portion, which carries the excavator and its motor; the box contains the oil and other accessories such as files. The excavator is formed of fuzed steel of great resisting power, and carries four blades of different lengths distributed before and behind.

The thickness of the clods of earth cut by each blade is 3 c.m. After the earth has been thrown up by the excavator, a leveller mounted on a rapidly revolving drum throws it against a kind of shield, which distributes it and regulates the profile of the parapet.

A special mechanism, by means of a hand lever, allows the excavator to be raised and placed in position for travelling on the road without being in action. The motor is located behind, and is arranged in the same manner as the motors of ordinary automobiles.

To be able to obtain the rotational velocity necessary for excavating all kinds of soils, a 150 to 200 horse-power motor is required. The wheels of the vehicle are similar to those of automobiles for heavy traction wagons, and the whole vehicle weighs about 2,500 k.g.

Detailed drawings of the plough with its excavator, and of the profile of the trenches, are shown at pp. 278, 279 of the *Revue*.

It is not understood how this plough could be used for excavating trenches during a battle, unless used at night, as its slow progress and somewhat cumbrous shape would render it an easy mark either for artillery or infantry fire.

EDWARD T. THACKERAY.

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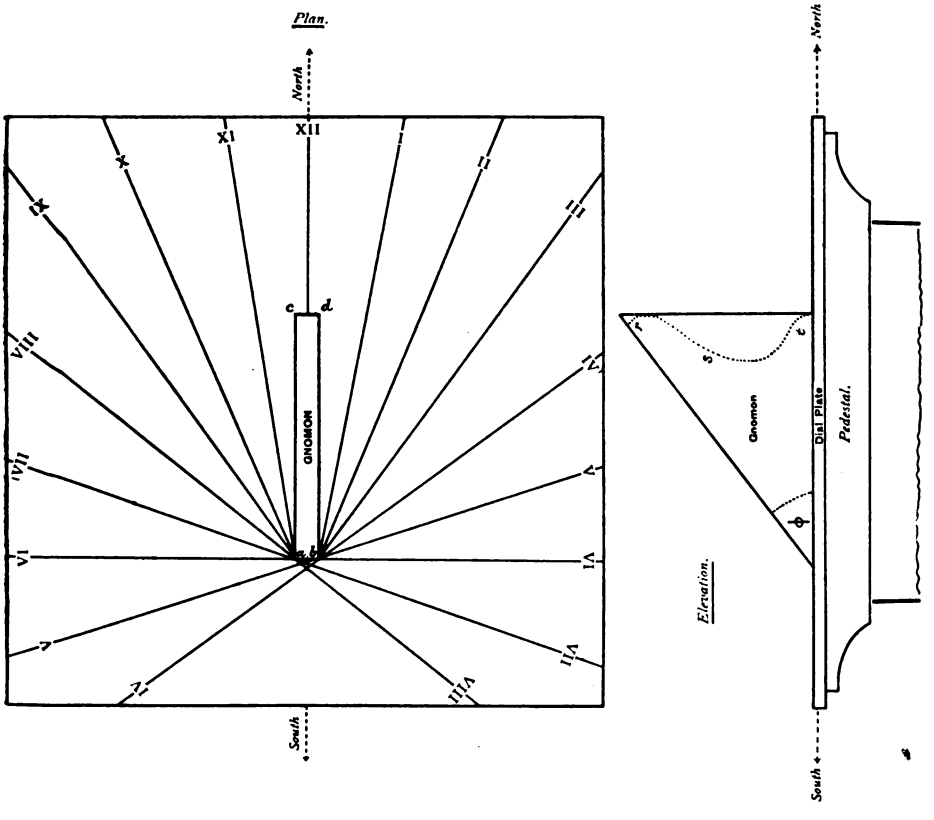
CORRESPONDENCE.

A SIMPLE FORM OF HORIZONTAL SUNDIAL TO GIVE LOCAL APPARENT TIME.



DEAR SIR,—In the April number of the *R.E. Journal* a description was given of the helio-chronometer. This led to a question being asked by an officer as to the method of constructing a simple form of sundial. The data for doing so are not easily available, and the following notes may therefore prove of interest.

The above plan and elevation represent a sundial for a North Latitude. For a South Latitude it is similar, but the markings are reversed, *e.g.*, II. o'clock = X. o'clock, and the Gnomon would point South instead of North as shown.

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Instructions for Construction.

The Gnomon makes an angle ϕ with the horizontal plane, where ϕ = latitude of place.

The Gnomon and XII. noon line must be accurately set in the plane of the meridian.

The graduations are made as under:—

For $\left\{\begin{matrix}\text{I.}\\ \text{XI.}\end{matrix}\right\}$ o'clock lay off an angle $x^{\text{I.}}$, such that

$$\tan x^{\text{I.}} = \tan 15^\circ \sin \phi \text{ (where } \phi = \text{latitude of place)}$$

For $\left\{\begin{matrix}\text{II.}\\ \text{X.}\end{matrix}\right\}$ o'clock lay off an angle $x^{\text{II.}}$, where

$$\tan x^{\text{II.}} = \tan 30^\circ \sin \phi.$$

For $\left\{\begin{matrix}\text{III.}\\ \text{IX.}\end{matrix}\right\}$ o'clock

$$\tan x^{\text{III.}} = \tan 45^\circ \sin \phi.$$

For $\left\{\begin{matrix}\text{IV.}\\ \text{VIII.}\end{matrix}\right\}$ o'clock

$$\tan x^{\text{IIII.}} = \tan 60^\circ \sin \phi.$$

For $\left\{\begin{matrix}\text{V.}\\ \text{VII.}\end{matrix}\right\}$ o'clock

$$\tan x^{\text{V.}} = \tan 75^\circ \sin \phi.$$

For VI. o'clock the lines are due East and West.

The lines are laid off as shown in diagram from XII. to VI. p.m., with centre of protractor at *b* and edge of protractor on *bd*.

Similarly, those for VI. to XII. are laid off with centre of protractor at *a* and edge along *ac*.

The markings IV. a.m. and V. a.m. are those of IV. p.m. and V. p.m., produced, *i.e.*, through *b*, not through *a*.

Similarly for VII. p.m. and VIII. p.m.

The above sundial will give Local apparent time.

Practical Points.

The Gnomon should be from $\frac{1}{4}$ inch to $\frac{1}{2}$ inch in thickness, and must be set up vertical to the dial and accurately placed in the plane of the meridian. The front side need not be perpendicular, but may be shaped to any curve desired, as shown in dotted line *r*, *s*, *t*, so long as the sloping edges, which cast the shadow, are clean and true and parallel to each other.

The Sundial is placed on a pillar some 4 feet high, which may be of any design required.

It is essential that the top should be horizontal, so that when the plate is bedded it will be horizontal too. If the top is square the edges should be located North and South and East and West respectively, so that the dial will not be on the skew, as the Gnomon must be due North and South.

Size of Gnomon and Plate.—This will vary with latitude. A trial could be made with a wood dummy to see what dimensions would be suitable.

Yours faithfully,

T. N. Dunman,

Lieut., R.E.

The Editor, *R.E. Journal.*

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STAFF COLLEGE, AUGUST, 1907.

The following Officers, whose names are arranged in regimental order, were successful from us at the recent Competitive Examination for admission to the Staff College:—

Capt. J. S. Cawley, 20th Hussars.
,, E. M. Birch, D.S.O., Royal Field Artillery.
,, P. W. Game, Royal Horse Artillery.
,, and Brevet Major C. B. Thompson, Royal Engineers.
,, R. Ommanney, Royal Engineers.
Lieut. G. P. Dawnay, M.V.O., D.S.O., Coldstream Guards.
Capt. W. Drysdale, Royal Scots.
,, G. H. B. Freeth, D.S.O., Lancashire Fusiliers.
,, R. S. Allen, Lancashire Fusiliers.
,, B. H. Chetwynd-Stapylton, Cheshire Regiment.
Capt. A. Crookenden, Cheshire Regiment.
,, and Brevet Major I. Stewart, Scottish Rifles.
Lieut. H. Needham, Gloucestershire Regt.
Capt. E. R. Clayton, Oxfordshire Light Infantry.
,, J. C. H. Newman, Essex Regiment.
,, L. A. E. Price-Davies, V.C., D.S.O., King's Royal Rifle Corps.
,, W. E. Davies, Rifle Brigade.
,, L. R. Vaughan, Indian Army.
,, J. Brough, Royal Marine Artillery.

The following Officers received nominations:—

Capt. the Hon. C. H. C. Guest, 1st Dragoons.
,, and Brevet Major E. D. Lord Loch, M.V.O., D.S.O., Grenadier Guards.
,, R. H. Mangles, D.S.O., Royal West Surrey Regiment.
,, H. W. Grubb, Border Regiment.
,, G. N. Cory, D.S.O., Royal Dublin Fusiliers.
,, G. D. Bruce, Indian Army.

WOOLWICH, NOVEMBER, 1907.

THIRD	F. N. M. Mason	7,441	27th	H. W. Crippin	6,411
FIFTH	E. J. Moorhead	7,236	32nd	L. H. King-Harman	6,372
SIXTH	C. W. R. Tuke	7,166	35th	R. B. Pargiter	6,339
24th	J. R. Pinsent	6,493			

This is the second time in two years we have passed THREE out of the first SIX for Woolwich

SANDHURST, NOVEMBER, 1907.

12th	C. W. Maxwell	5,172	27th	C. T. Ellison	4,912
13th	R. C. Money	5,169	38th	B. C. H. Keenlyside	4,644

CAVALRY, NOVEMBER, 1907.

7th ... ... A. M. Sassoon 3,481

WEST INDIA, NOVEMBER, 1907.

SECOND ... ... F. T. Hughes 4,331

INDIAN POLICE, JUNE, 1907.

THIRD	F. W. Toms	6,886	27th	H. W. Waite	5,980

ARMY QUALIFYING, MARCH, 1908.

Six were successful from us.

MILITIA COMPETITIVE, MARCH, 1908.

Douglas Scott, Kent Artillery.
D. G. Gunn, 3rd P.W.O. West Yorkshire Regiment.
A. L. Cooper Key, 5th Middlesex Regiment.
W. C. Loder Symonds, Lancashire Field Artillery.
R. G. Atkinson, West Surrey Regiment.
R. W. Leach, Cambridge Volunteers.
G. W. Courtney, Cork R.G.A.

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THE ROYAL ENGINEERS JOURNAL.

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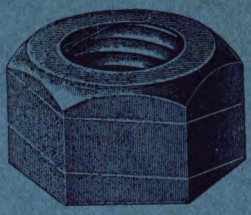

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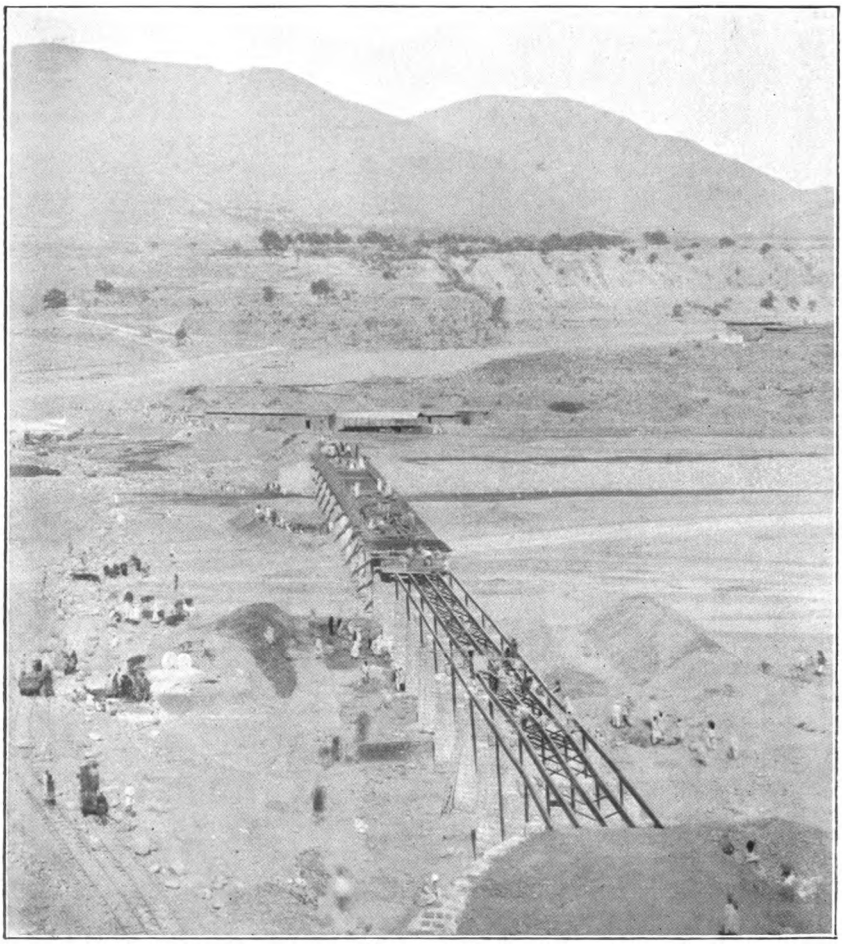
DORE BRIDGE.



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STUDIES ON THE USE OF FIELD TELEGRAPHS IN SOUTH AFRICA.

By MAJOR E. G. GODFREY-FAUSSETT, R.E.

III.—LORD ROBERTS' MARCH ON BLOEMFONTEIN.

A TELEGRAPH DIVISION ACTING WITH A FORCE OF SEVERAL DIVISIONS.

THE great feature of the start for the march to Bloemfontein was the absolute secrecy which was maintained as to the Commander-in-Chief's intentions. Very few officers were in the secret, and no one was more bewildered than the telegraph officers when orders were issued at the end of January, 1899, for the concentration at Modder River.

By February 8th, Nos. 2 and 3 Sections were at Modder River, and 10 additional buck wagons and teams were drawn from the transport to carry spare air line, cable, and forage. On the 9th the sections trekked south to Enslin, marching with 3 officers, 69 N.C.O.'s and men, 63 natives, 290 mules, 30 ponies, and 32 vehicles. Mules had fortunately by this time been substituted for the oxen originally issued for G.S. wagons, and a number of boys had been incorporated in the air-line detachments to do the hammer and jumper work, thus freeing the sappers for more important duties.

The water at Enslin was scarce, so that the whole caravan had to go on six miles to Botha's Farm for the next day, and even then the mules had to go four miles to water.

On Sunday, 11th, the start was made, air line being run from Enslin to Ramdam—nine miles of terrible going in great heat. The ground was so dry that jumper holes filled in at once, and nearly every pole had to be dug in with pick and shovel. Moir ran cable in advance with the cavalry, a cart remaining to pick it up when replaced by air line.

Mackworth's section (No. 4) arrived at Enslin by train from Rensburg, and joined the remainder at Ramdam.

The Cavalry Division under General French assembled at Ramdam on the 11th, and left for the drifts of the Riet River at 2 a.m. on the 12th. They were accompanied by a cable section under Moir, who kept them in touch with the air line office at Ramdam. The VII. Division followed later, reaching De Kiel's Drift in the evening. Four air-line parties continued the line in the same direction as far as

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9-Mile Vlei, where they tapped in on Moir's cable, but owing to want of orders got no further on the 12th. A column which had been formed of all the spare telegraph wagons got astray and went to De Kiel's Drift, so that the air-line detachments were without food, save for a sheep purchased at a Kaffir kraal.

On the 13th Moir went off north with the cavalry who secured by the evening Rondeval and Klip Drifts on the Modder. The air line was run on to De Kiel's Drift, but just as it was being finished orders were received to change the point of crossing to Waterval Drift. Some five miles of air line were abandoned, a new line run, and an office opened at Waterval by 3 p.m. This change necessitated the abandonment of Moir's cable if it went wrong, which needless to say it did.

During the night of the 13th the VI. Division crossed at Waterval and marched to Wegdraai, accompanied by a cable laid by Mackworth. The Division pushed on again on the 14th to Rondeval, and in this manner touch was regained with the cavalry through Mackworth's cable.

Early on the 14th the sole use of the drift at Waterval was obtained for half an hour, and the wagons were got across by dint of using double teams. An office was left at Waterval, and the air line pushed on 10 miles to Wegdraai by 1 p.m. Advantage was taken of the early hour to run it on $2\frac{1}{2}$ miles further towards Rondeval in preparation for the next day.

During the 15th, headquarters was stationary at Wegdraai; Mackworth, with an escort, completed the air line to Rondeval (14 miles), and Moir accompanied General French to Kimberley with cable. All the morning the communication was good in both directions, but the air line to Enslin was cut at Waterval when the convoy was attacked there by De Wet. General French reported the relief of Kimberley by cable and by search light *viâ* Modder River. A small party accompanied the 15th Brigade to Jacobsdal, repairing the permanent line. The party came under fire and lost several mules.

On the 16th headquarters moved to Jacobsdal, and Henrici ran out air line towards Modder, meeting a detachment working out from thence under Capt. Fowler (14 miles). In this way the base was shifted from Enslin to Modder, and all lines laid in rear were abandoned.

Early in the morning Moir's cable from Rondeval to Kimberley was completely destroyed by the whole of Cronje's force trekking over it.

Next day (17th) Mackworth accompanied the VI. Division with cable to Paardeburg. The line from Wegdraai to Rondeval was repaired (it had been cut in two places, and two linemen sent out to repair it were captured), and the air line was continued to near

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Drieput's Drift, where the detachment bivouacked under escort of Nesbitt's Horse.

The 18th was the day of Lord Kitchener's attack on the Paardeburg laager. Good communication was maintained through Mackworth's cable, and the air line was pushed on to Sterkfontein. Three parties were sent back to run a direct line from Jacobsdal to Rondeval, and so cut out the loop by Wegdraai.

On the 19th Lord Roberts passed through to Paardeburg, and a fresh cable was run from Sterkfontein to his camp. On the 20th the air line replaced it, and on the 22nd the air line was pushed on to Koodoesrand, which remained the extreme point until the 7th March.

For a fortnight, during which the army remained at and about Paardeburg, the hardworked air-line detachments got good rest, though food was scanty and water bad. Unfortunately the question of forage was a difficulty—the telegraphs, as Army troops, were no man's child, and the O.C. had to arrange with his own transport for supply from the parks.

The operators had a very busy time, for the work at Paardeburg, and, later on, at Osfontein—where headquarters moved on 1st March—was very heavy, and necessitated the presence of an officer in the office all day to sort out those messages which would best bear delay. After Cronje's capitulation nearly every public body in England thought it necessary to telegraph their congratulations to Lord Roberts. The Wheatstone would have been invaluable, but it was all in use elsewhere, and the line was worked duplex day and night without cessation.

Moir went back with an air-line detachment and repaired the permanent line from Jacobsdal to Kimberley, thus shifting the base to the latter place, where there was more accommodation than at Modder River. A convoy came in on the 3rd with more air-line stores. Moir remained in rear with his detachment, strengthening the air line, on which breakdowns were frequent. Most of these were due to the convoys, who found the line a useful guide at night, and repaid by knocking it down. On one occasion nothing was found of two miles of line but pieces of wire and small scraps of poles.

On 7th March the advance was resumed, an attack being made on the Boer position at Poplar Grove. A cable cart, under Mackworth, accompanied the cavalry on the right, running out 26 miles from Osfontein; another cart kept Lord Roberts at Le Gallais Kopje in touch with Osfontein, and a third cart based on Koodoesrand worked with the balloon and the extreme left under Henrici.

By 12 noon the enemy was in full flight, and Henrici's cable was pushed on to the bivouac at Poplar Grove. The air line was only able to reach Makauws Drift, but it was in to Poplar Grove by 10 a.m. on the 8th, and was pushed on four miles further in the afternoon.

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Headquarters remained at Poplar Grove on the 8th and 9th. The air line was continued eight miles further with an escort of mounted infantry, and Mackworth ran cable with the cavalry to Abraham's Kraal.

Next day's air line was delayed by the Battle of Driefontein, the air-line detachments coming under fire as they were working into the farm.

On the 11th the air line was at Aasvogel Kop (headquarters) by 4.30, and was pushed on to Doornboom afterwards; and on the 12th the air line reached Venters Vallei, while Mackworth ran cable with the cavalry to the railway at Ferriera siding.

At Venters Vallei Lord Roberts authorized the O.C. to express to the detachments his approval of the work that had been done. He at the same time stated that it would be unsafe to leave linemen and intermediate offices on the line, so Moir, who was still in rear, was told to come in through the line, bringing in all maintenance parties with him.

By 11.15 on the 13th the cable was in to Bloemfontein, the telegraph office seized, and all communication with the north cut off. Unfortunately the cable was cut just before, and by the time the air line reached rail it too had gone in rear. As it was impossible to send linemen back—the break might be anywhere in 125 miles—things seemed hopeless, and it was with indescribable feelings that the O.C. watched Lord Roberts send off his despatch containing the news of the occupation of Bloemfontein by despatch rider. A copy, however, was given to the telegraphs, to be sent if it were possible.

By reading the messages left in Bloemfontein office, it was discovered that the Boers had been using the Bloemfontein-Boshoff line till the last moment, and on the 14th, Mackworth and Sergt. Cadwell volunteered to ride through and repair it. This they succeeded in doing after many adventures, stealing ponies to replace their own tired beasts from a Boer laager encountered *en route*.

Henrici went south by train with the advanced parties to meet General Clements' advanced guard, and a wire was working by the evening of the 14th.

But at 6 p.m. on the 14th the operator who was watching the useless instrument on the Kimberley air line suddenly obtained signals, and Lord Roberts' despatch was immediately sent off, beating the despatch rider, as we afterwards heard, by two or three hours. The break had been in front of Moir, and he had repaired it as he came through. After this the air line worked for 10 days without any maintenance.

On the whole it may be claimed that the telegraph communication was successful. Touch with the base was never lost for more than a few hours, and the work was nearly always cleared during the night

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The episode is, however, prolific in lessons, most of which have been learnt, and have affected the present organization.

(*a*). The operations of General French's Cavalry Division illustrate the hopelessness of trying to keep in touch with strategic cavalry by means of cable. Touch was lost between De Kiel's Drift and Klip, and only regained because the infantry reached Klip. It was lost again between Klip and Kimberley when Cronje crossed, and never regained; and no attempt could be made to follow the cavalry from Kimberley to Paardeburg. No cable is now allotted for this work, but two wireless companies are available.*

(*b*). Cable sections are required to keep the Commander-in-Chief in touch with his divisions. Little could be done in this way, owing to want of men and cable carts. Mackworth's line on the 13th and 14th is an example; also the work at the Battle of Driefontein, where Lord Roberts, in the centre, was in touch with both his flanks. This is now provided for by the cable companies forming part of the Army troops.

(*c*). Cable is still required with air line, to get communication when the air-line parties are overtaken by darkness before completing their line, *e.g.*, Henrici's line on the afternoon of March 7th. Each air-line section now has a cable wagon for this purpose, and for working through woodland, where air line would be prohibitively slow.

(*d*). The Battle of Paardeburg is a good illustration of the necessity for telegraphic communication from Commander-in-Chief right down to battalion commanders. To quote from the official history:—"It would seem probable that Cronje's main laager might have been carried during the afternoon of the 18th had the attacks from east and west been better synchronized, and had they been delivered by a combined effort of all the troops available on each flank." *War Establishments* now provide a cable company of three detachments for the internal communication of each division, and a section of two mule detachments for each brigade.

(*e*). The four air-line detachments and three officers available (after deducting officers and men utilized for cable) were insufficient to keep three divisions in touch with their base without unduly hard work. The presence of the Commander-in-Chief of all the troops in South Africa made the traffic enormous; an officer should have been available at all times for duty in the headquarter office, and a second line for local work would have been a great help. The present organization allows for six air-line detachments, and six officers (one air-line company) for a similar force.

(*f*). Owing to the tendency of supply columns, marching at night, to follow and break down the line, care should be taken to run it

* For further elaboration of this see an article by the same author in the *Cavalry Journal* for July, 1908.

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over inaccessible places, so as to discourage the practice. This was done between Paardeburg and Bloemfontein with good results. In a country of roads and hedges the line should always be over the hedge. Great trouble was also occasioned by mules grazing near the bivouacs—every pole had to be surrounded with a trench and bank to keep them off.

(*g*). The supply question was a daily anxiety, as the telegraphs were the only Army troops, and no supply column was available. The supply of the scattered telegraph detachments must always be a difficulty, but fortunately each air-line section and each cable detachment is complete with its own transport. In addition, an Army Troop Supply and Transport Column now appears in *War Establishments*.

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DESCRIPTION OF A FERRO-CONCRETE BRIDGE IN THE BRITISH INFANTRY LINES AT AHMEDNAGAR.

By MAJOR A. H. D. RIACH, R.E.

THE following description is that of a bridge constructed to carry the road to the new British Infantry Lines at Ahmednagar, over a shallow nullah of an average width of 30 feet, the water in which rises on occasion to a depth of 3 feet and more. The original estimate provided for stone masonry piers and a decking of steel trough plates on rolled steel girders, at an estimated cost of £216, and the present ferro-concrete structure was substituted to demonstrate its practicability and comparative cost.

The load to be borne is a 10-ton steam roller, or a distributed live load of 75 lbs. per square foot of road surface. The design adopted provides for six ribs of parabolic form, 1 foot in thickness, 6 inches deep at crown, with 15 feet clear span, a 3-foot rise from haunch to crown, spandrels filled in solid, and spaced at intervals of 3 feet in the clear. These ribs support the decking, also of ferro-concrete, 9 inches thick at centre of roadway and 6 inches at the edges.

Practical considerations decided the form and general dimensions of the ribs, and they are therefore larger than theory demands, as it would have been difficult to construct them had their proportions been determined by calculation alone. The upper surfaces of the ribs are all in one horizontal plane; the camber of the surface of the decking provides a greater strength under the roadway proper, and also allows for the water percolating through the road surface to drain away.

The foundations were on soft rock, and consisted of lime concrete, with a small addition of cement in the top layer. The pier and abutments, of coursed rubble stone in lime mortar, were first completed up to the level of the top of the ribs, leaving spaces into which the concrete of the ribs was to be rammed.

Two moulds—or centerings—of planking with open ends and lined inside with galvanized sheet iron were then supported between the piers and abutments, so as to form one complete trough over the two spans of the bridge, 38 feet long, 1 foot wide, and from 3 ft. 6 ins. to 6 inches deep. The ends of this trough were formed of the masonry filling referred to above. The sides of the moulds were kept in position by bolts passing through sleeves of piping, or bent pieces of iron sheeting, which formed distance pieces. These were placed

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4 inches from the top edge of the mould, and in the positions where the shearing bars were to come.

The armouring for each rib consisted of:—

(*a*). 2 rods, $\frac{3}{4}$ inch diameter, following curve of parabolic intrados.

(*b*). 1 rod, $\frac{3}{4}$ inch diameter, so bent that its ends came in decking and its central portion followed the curve of the parabolic lying between the two rods (*a*).

(*c*). 2 rods, $\frac{3}{4}$ inch diameter fixed horizontally over rods (*a*), and 4 inches above top of moulds (so as to come into the decking).

(*d*). 26 shearing bars, $1\frac{1}{2}'' \times \frac{1}{4}''$, hooked on to rods (*a*) and (*c*).

This armouring, previously bent to template, was fixed in position in the moulds, rods (*b*) and (*c*) being supported on wooden blocks laid across the top of the moulds, bars (*d*) tied to the sleeves above mentioned, serving to support rods (*a*).

No trouble was experienced in getting the armouring into the correct position, and it was kept from being displaced during ramming by men with small handspikes. The ends of all rods were fish-tailed, and the two rods were bound in the usual way at joints. The moulds and armouring being ready, they were brushed over with a cement wash, and the mixing and ramming of the concrete was then done. The proceedure was as follows:—

Four cubic feet cement and 2 cubic feet sand were mixed dry and added to a heap of 12 cubic feet of clean ballast, consisting of equal parts of $\frac{3}{4}$-inch gauge trap metal and shingle up to $\frac{3}{4}$ inch, out of which the fine sand had been screened. This was well mixed dry, and a few basketfuls then wetted and turned over and at once carried to the moulds and rammed. The supply of wet concrete was maintained continuously, one lot as above taking about $\frac{1}{2}$ hour to mix, lay, and ram.

The haunches were first filled in and completed, and work gradually carried from both sides towards the crown, which was then filled in and rammed with special care, a mixture of 3 cubic feet ballast and $1\frac{1}{2}$ cubic feet cement being used.

Ramming was done with heavy poles and iron rammers, as found possible. The concrete was well tamped by two men with flattened handspikes, about the armouring, and particularly at connections of shearing bars.

The sides of the moulds were sometimes removed on the second day, and the surface of the concrete rendered where necessary. It was found that a rather wet quaking mixture gave the best surface, but caused cavities, due to the mortar running out in any places near leaks in the mould. Care is therefore necessary to minimize such leaks. The centerings were taken down on the 6th day and the moulds re-erected for the next rib.

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Progress was as under :—

25th April,	1907	... Filled No. 2 rib.
30th „	„	... Removed centering, watching through level, no observable movement.
4th May	„	... Filled No. 3 rib.
9th „	„	... Removed centering.
11th „	„	... Filled No. 4 rib.
17th „	„	... Filled No. 5 rib.
29th „	„	... Filled No. 6 (outer) rib.
4th June	„	... Storm cleared away centerings.
9th „	„	... Filled No. 1 (the last) rib.

On the outer ribs spandrel panels were moulded by means of bevelled planking fixed on to one side of the moulds. The ribs were kept under grass, and watered until the decking was laid.

The centering of the decking consisted of corrugated iron sheets on wooden battens, supported on baulks of wood bolted to the ribs by means of bolts passing through the sleeves already mentioned. This device was very convenient in practice, and obviated the damage from floods to the centering which would have occurred had it not been borne by the ribs.

The armouring of the decking consisted of :—

(*e*). Longitudinal bars, $\frac{5}{16}$-inch diameter, 3 inches centre to centre, laid from end to end of the bridge, and wired at each point of contact to rods (*f*). These rods were omitted over the ribs.

(*f*). Rods, $\frac{3}{8}$-inch diameter, 3 inches centre to centre, transversely to the ribs and of the full width of the completed decking. Every alternate rod was bent to template so as to come over the rods (*c*) of the armouring of the four inner ribs, and was attached thereto with wire binding. The remaining rods are at the lower side of the decking.

The grill, formed as above, was packed up so as to be $\frac{1}{2}$ inch clear above centering. The surfaces of the ribs were roughed and washed, and the joints between the corrugated galvanized iron centering and the ribs, etc., filled with mortar and wooden fillets. The concrete of the decking was then laid, mixed as before, and filled and rammed in diagonal strips of full depth required. The surface was at once rendered, and on the second day was flooded with water.

Decking was completed as above from centre to centre of outer ribs; one span on 22nd June, 1907, and the second on 11th July, 1907.

Care was needed to ensure decking being of requisite thickness; a number of small bits of rod, bound to the grid and set up vertically, with their tips at the required level, served as gauges for the ramming of the finished surface.

The dwarf parapets, including the outer 1 foot of the decking, the

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railings, and railing pillars were then completed. The pillars were rammed into moulds *in situ;* their steel joists, used as standards and railings, formed a very substantial and cheap railing.

The cost of the completed bridge—omitting the wing walls, etc., and the protective apron to prevent scour, but including the materials used for centerings, etc.—was £197, and the total cost, including hand rails on approaches, etc., £250.

The price of cement was 12s. a cask; about 80 casks were used. The steel bars cost nearly 10s. a cwt. in store; about 65 cwts. used. Labour was very unskilled, and a good deal was wasted.

The rendering of the surfaces was only needed in a few places, and should be done sparingly, as such application is subject to hair cracks and is a disfigurement to sound concrete.

The work should be done under thoroughly reliable supervision during the whole of the time the concrete is being mixed and rammed. The average quantity of materials used, per rib of cubic capacity of 72 *c.f.* was 72 *c.f.* ballast, 24 *c.f.* cement, and 12 *c.f.* sand.

The centering of the decking was removed on 1st August, 1907, leaving a very even, clean surface. The structure is as nearly monolithic as it is possible to make it. Beyond a few small hair lines, no cracks due to expansion and contraction have been found. The road was thrown open to light traffic and a 2-ton bullock roller sent over the bridge on 20th September, 1907.

On 21st October, 1907, two months after its final completion, arrangements were made to test the structure. The 10-ton steam roller was driven along a chalked line, so that one hind wheel should come centrally over one bay of the decking. Pencils attached to balanced lever arms, in contact with the under surface of the loaded bay and the adjoining rib, were set to give a record of the vibrations and resiliency of the material. The result, after sending the roller over slow and then at a medium pace, was *nil.* I then sent the roller up the hill, so as to gather momentum, and had it driven over the bridge at its highest speed, but was unable to perceive any vibration whatever, although I held my hands against the loaded bay and rib.

The conclusion arrived at is that a better bridge has been built for the money than that originally contemplated, and that a very considerable saving will result from the adoption of the same type of construction in larger spans.

In the present case the cost might safely have been reduced by the omission of the armouring in the ribs and by the use of a less rich concrete. The proportions of armour and cement were intentionally increased, as the behaviour of masses of concrete under the existing conditions of climate had not been tested practically.

The time taken could have been shortened very much if required, and as the materials used are all portable, a similar bridge could be made in any locality.

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*DORE BRIDGE.**

By COLONEL G. K. SCOTT-MONCRIEFF, C.B., C.I.E., R.E.

THE Dore River is a tributary of the Sarin River, which again is a tributary of the Indus, flowing into that river near the village of Torbela, where the Indus first begins to emerge from its mountain home.

The area drained by the Dore, at the point where the main road from the N.W.R. at Hassan Abdal to the military station of Abbottabad crosses it, amounts to 138 square miles. In the upper reaches this area is covered with forests, which in themselves would prevent the rainfall from passing off quickly; but the slopes of the hills which are thus timbered are exceedingly steep, so that rapid and violent floods are very frequent in the rainy season. The lower gorges of the stream and its tributaries are not so well wooded, but the hills are just as precipitous there as they are further up. The greatest height of the watershed is about 9,900 feet above sea level, the level of the bridge being at 2,770 feet above sea level.

At the point where the bridge is built, the river has worked for itself a trough-shaped bed through the alluvial plateau of the Hazara Valley. The bed of the stream is of gravel and small boulders extending to an unknown depth.

Just below the bridge site the Dore is joined by a tributary nullah called the Salhad, a stream which comes from near Abbottabad, draining an area of some 24 square miles, but with a bed slope so steep, that its floods are often more dangerous than those of the Dore.

It would appear at first sight as though the natural site for the bridge would have been below the junction of the two streams; but there were two reasons against this. One was that the existing road finds its way by a winding ascent to the top of the plateau on the right bank of the Salhad, and has close beside it a third nullah—the Banda—which would have had to have been bridged if the site for the

* The description of the construction of this bridge, and of that over the Kharmana River, published in the August number of the *R.E. Journal*, is taken from notes made by the author at the time. Plans and illustrations of these works were given in the *Professional Papers* for 1905, "Recent Works in the N.W. Frontier Province, India," but, owing to limits of time in the lectures, delivered at the S.M.E., then published, it was only possible to describe very briefly the construction of these works. It is thought that some further details may be of use to officers who have similar work to carry out.

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main bridge had been lower down. The other reason was that below the junction of the Dore and the Salhad, the bed of the stream widens out to such an extent that either the bridge would have had to have been very long, or its training works would necessarily have been of a very colossal character.

The road from Hassan Abdal to Abbottabad was made in the early years of our occupation of the Punjab, and gradual improvements in gradient and metalling were made from time to time, so that it is now a first-class metalled road as far as the borders of Kashmir (79 miles), with a ruling gradient of 1 in 20. Although there are bridges over the greater number of the water courses traversed, yet on a few of the largest the crossing was effected on tracks made through the bed of the stream, which of course were liable to be blocked at any time by rain.

Of these the most troublesome was the Dore, the crossing there being about 400 yards long, and after every heavy rainfall the traffic was interrupted for from two to six hours, and sometimes as much as two days. Frequently fatal accidents occurred from carts becoming involved in the stream when the flood was rising, and despite the fact that every rainy season special gangs of men were kept to assist carts across, there was every year a number of such accidents.

The question of providing a bridge had been repeatedly pressed by both civil and military authorities for years, but it was not until about 1891 that the subject was taken up as a definite engineering project. The preliminary investigations and the design are the work of Mr. H. C. Granville, now Superintending Engineer, Punjab P.W.D.

Careful comparative estimates were made out in the initial stage of proceedings, as to the relative cost of various classes of work, *e.g.*, whether the bridge should have 20-foot, 30-foot, or 40-foot spans, and whether the decking should be trough plates or timber. It was ascertained that 30-foot spans with timber decking would be the most economical. In this preliminary investigation it was assumed that the foundations need not be carried more than 12 feet, that ordinary lime mortar might be used, and that it would be possible to carry out the work with very little pumping.

Probably if the officer who made out the first estimate could have foreseen the difficulties which arose from the quantity of water in the foundations, and the necessity for using cement, he would have allowed for much longer spans. The use of timber for the decking was on account of economy. Tarred deodar wood has been used with very satisfactory results in many bridges in North India.

The actual site of the bridge was fixed at a point slightly above the old road crossing. The stream here passes in a trough, some 300 yards wide, between high bluffs of clay and boulders some 30 feet to 40 feet high. In time of flood the water fills the trough from bank to bank, so that anything like diverting the river as a whole is

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impossible. All that one can do is to divert the stream from any given part, with the knowledge, however, that the next flood will almost certainly overtop or outflank one's efforts.

The nature of the bed is gravel mixed with boulders, but the latter are not large. The author has observed that where the bed of a stream is interspersed with large and heavy boulders, the scour is not nearly so great as where the boulders are few or small. In a stream where the bed is composed of fine gravel or sand, the scour will probably be greater than in a bed where there are large boulders and rocks, and also in the former case water may be found at a comparatively shallow depth and in considerable quantities. The author merely states these opinions *as a general rule*, founded on personal observation, and he gives the opinion for what it is worth, as he cannot assign any very satisfactory reason for it.

It seemed, therefore, that in the Dore the scour would be considerable.

The longitudinal slope of the bed is 71·99 feet per mile. Near the bridge the slope is 1 in 72. The calculated velocity of the stream when in full flood was 15 feet per second, and the discharge 73,000 cubic feet per second. This was equivalent to a rainfall of $\frac{3}{4}$ inch over the catchment area, and admitted of the bed being scoured between the piers for about 2 feet. The height of the piers was fixed at 6 feet from highest flood level to the underside of the girders.

The work had been begun in November, 1901—the steel work having being ordered from England—when the author took over from the Punjab Government the charge of the military and civil works in the N.W. Frontier. On his first visit to the work, which had barely been started, he came to the conclusion that the provision of some more hydraulic mortar than the ordinary fat lime of the country was necessary, and he also thought that where there was so great a velocity and so friable a bed, the scour would be greater than was supposed, and that if no floor or curtain wall was admitted, the foundations ought certainly to be more than 12 feet deep. He also realised that the inflow of water into the foundation excavations was such as to necessitate steam pumps.

He therefore stopped the little work which had been begun, pending reference to the Government of India, to whom he explained his views. He reported a possible discharge of 78,000 cubic feet per second, and a velocity of 16·6 feet per second. The Government of India agreed that the conditions of the case necessitated deeper and stronger foundations.

The design purposely reduced the waterway from 4,700 square feet to about 3,500 square feet, and as the calculated velocity of 16·6 per second was based on the assumption that the river occupied its total unrestricted bed, it was evident that, with the waterway reduced by about 25 per cent., the velocity would be enormous, and

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it was considered that a floor, apron, and curtain wall were necessary The curtain wall was to be 20 feet deep if possible, and 5 feet wide, and the floor 3 feet thick. The pier foundations were left at 12 feet.

The height of the piers was at the same time raised, so as to allow for the extra height of calculated afflux. A 6-foot clearance had been provided, which was increased to 10 feet.

Subsequently in construction after some experiments it was found that large boulders, with cement concrete rammed into their interstices, gave the best floor, and it stood the test of several severe floods without anything being displaced. And as, during construction, the floods had to be diverted from parts still under construction to those that had been finished, the test of having a concentrated rush of flood-water over fresh flooring was undoubtedly severe.

The fact that the depth of water allowed for would have to be increased owing to the construction of the floor, affected also the design of the training works. These were made 11 feet high up-stream.

It may here be noted that although often in such works the training works are simply earthen banks faced with stones, it was here considered advisable to make the work of stone throughout.

A revised estimate was therefore made out on the above lines, and the rainy season of 1902 was devoted to making the preliminary arrangements, viz., building workshops and a small inspection house for the engineer in charge, and also laying a small railway to the quarries four miles off, collecting other materials, and getting pumps and cranes.

The quarries provided excellent limestone in massive blocks, and as the line to them ran up the steep bed of the Salhad, it was possible to have the loaded trucks going down hill by gravity alone, the return empties being easily hauled up by animals.

In the Salhad too there were plenty of boulders weighing up to half a ton, suitable for the training works and floor.

Four swinging derricks and cranes mounted on trucks were made up. These took the boulders or the quarried stone off the travelling trucks and placed them *in situ* on the training works. In the deep excavation for the curtain wall, however, where the masonry was made of as massive and substantial a character as possible, it was not possible to use the cranes for depositing the blocks directly in position. To have done so would have necessitated the use of timber shoring, and after careful consideration it was resolved to give up the idea of this. Timber shoring would no doubt have enabled the work to have been done more easily and possibly more quickly, but it was not procurable anywhere near (the timber in the adjacent hills being under the Forest Department), and as the nearest railway station is 33 miles off, the cost of transporting it to the site from a distance would have been very great, especially when the chances of

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the work being swamped by floods (as it frequently was) and the possible damage to the timber arising therefrom had to be considered.

The railway line was therefore laid parallel to the line of the excavation but at a little distance from it, and the materials were run down an inclined plane of rails.

The pumps which were at first available were a 9-inch centrifugal and 12-H.P. engine, which had been lying disused in a store for years, and a 6-inch centrifugal and 10-H.P. engine, which were fairly serviceable though old. The 9-inch centrifugal would have been a useful pump if it had only been reliable, but it broke down so often at critical moments that at last it was considered better to remove it altogether.

Fortunately the Connaught Bridge at Chakdara had now reached a stage where it was possible to dispense with some of the pumps, and two 10-H.P. engines with 6-inch centrifugals were brought to the Dore, after it had been proved by some weeks of ineffectual struggling with the great inrush of water and untrustworthy pumps, that the work was being seriously retarded. These two fresh pumps were able to cope with the water easily, and once they were set in action the difficulties of excavation and building soon disappeared.

It was decided to take out the excavation for the curtain wall in lengths of 100 feet. This meant about 7 shifts of the pumps, which worked in sumps situated a little below the main excavation. Of course by excavating so great a length as 100 feet the quantity of water which had to be dealt with was relatively great, and if there had not been the ample pumping power above alluded to, it is probable that the lengths taken out at one time would have necessarily been reduced. But it was obviously desirable to have as few changes in the position of the pumps as possible, and it certainly tended to better work to have a considerable length of the wall done at one time.

Work was actually begun about the end of October, 1902, but in the end of the year and in the early part of 1903 there was a succession of floods which delayed the work most seriously, in nearly every case filling the excavation and leaving quantities of gravel and silt behind. Of course temporary diversion works were made and were very useful, but sudden and violent floods often outflanked these and caused much damage.

These floods also damaged the light railway from the quarries, and the supply of stone often ran short on this account.

The foundation of the curtain wall was laid (as in the case of the Chakdara Bridge) by means of large bags of coarse cement concrete 10 to 1. Above this the roughly-squared blocks of limestone were laid, with cement concrete rammed into the interstices. All masonry and concrete below R.L. 2690 was laid in cement mortar.

It was hoped that the bridge would be ready by August, 1903, but

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the repeated floods from January to May so retarded the work as to render this impracticable. The bridge was actually open to traffic early in November.

The construction of the piers, the erection of the steel beams, and the laying of the flooring presented no difficulty.

The estimated cost as sanctioned was Rs.219,904, the actual cost being Rs.179,000.

The quantities were:—Dry boulder work, 399,000 cubic feet; rubble masonry, 181,394 cubic feet; excavation, 554,000 cubic feet; concrete, 11,000 cubic feet.

Lieut. D. Ogilvie, R.E., was in charge of the works from November, 1902, until April, 1903, when he was relieved by Capt. G. C. Kemp, R.E.

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WATER SUPPLY COMPANIES.

By Capt. P. H. French, R.E.

The question of the organization of distinct companies to deal with the water supply of an army in the field, has not I believe hitherto been put forward. The subject however seems well worthy of discussion in the pages of our *Journal*, owing to its importance both as regards co-operation with the medical and sanitary branches in preventing the outbreak of disease; and also so as to secure as pure, liberal, and well distributed a supply of water as is possible, under any possible circumstances.

The actual approval of the source of water supply, is clearly defined in *Combined Training* as a duty of the medical branch, but all subsequent work in connection therewith should be an Engineer service. Under existing conditions field companies carry out the work of the supply and distribution of water in camps; but there are many who urge that they should be left free for military engineering pure and simple. Their work lies more with the fighting troops, and not in performing a duty which, however important, is apt to interfere with their fighting efficiency. There are specialist companies for telegraphs, balloons, search lights, railways, etc., and surely in these days, when the vital importance of a good water supply is so thoroughly recognized, a specialist water supply company would seem to be a very serviceable innovation.

It may be objected that there is not sufficient work in connection with this one subject alone, to justify the formation of separate units to deal with it, but a consideration of the following points may modify this view:—

(*a*). The location of underground water calls for geological training and careful study. The engineering involved in bringing it to the surface calls for special plant, detailed knowledge of its operation, and skilled labour.

(*b*). The water of wells, lakes, ponds, rivers, etc., is generally contaminated to a greater or less extent

(i.). Chemically (rarely dangerously).
(ii.). Bacteriologically.
(iii.). By solid matter in suspension.

The examination and detection of such impurities is the work of the medical branch, but under a properly organized system their removal can be undertaken by engineers, as is done in civil life.

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Before going further, however, the subject may be considered under two distinct headings, *i.e.* :—(*a*). Water supply of an army on the move. (*b*). Water supply of lines of communication.

As regards (*a*), the ever-present time factor renders it impossible to attempt a great deal, and if the available supply is made as drinkable as time permits, and its distribution accelerated as far as possible, nothing more is called for. As regards (*b*), however, a very great deal can be done, and, as in this case camps become semi-permanent, the matter becomes one of the greatest importance.

To cope with both (*a*) and (*b*) a "Divisional Water Supply Company" would seem to be necessary, one section being equipped for (*a*) and the remaining sections for (*b*). As mobility is essential, the section for (*a*) would have to be mounted and equipped with small but powerful pumps, operated by petrol engines, a considerable supply of fire hose, and canvas tanks and troughs for distribution purposes.

A very great amount of 2½-inch fire hose can be carried in a remarkably small space ; it is light, extremely portable in every way, resists wear and tear well ; is easily and rapidly connected up ; and the conjuring that can be done with a combination of fire hose, tees, crosses, reducers, and taps, is remarkable.

The (*a*) section would also carry the sterilizing or filtering plant ; and in connection with this point I would call attention to the Forbes Patent Portable Outfit for water sterilization, described and illustrated in *Engineering News* (New York) of 31st October, 1907. This sterilizer has a capacity of 400 gallons per hour of filtered and sterilized water, at an increased temperature of 16° Fahr. to resulting water. It has been specially designed for the United States Army, and appears to be eminently serviceable and portable.

The (*b*) sections would be dismounted and under the command of officers who have specialized in water supply. They would be equipped with powerful mobile pumps, filtering and sterilizing plant of greater capacity, apparatus for procuring underground water, and piping etc. Some may think that such specialization is unnecessary ; but when large masses of humanity are together for some time in one place, water supply becomes a study in itself, and general knowledge of water supply is insufficient.

No details have been entered into in the above, nor have the *pros* and *cons* been fully discussed. The article has been written more with a view to calling attention to what would now seem to be a very necessary branch of specialization for the Corps, and also in the hope that it may elicit the opinions of senior and more experienced officers as to the necessity or otherwise of water supply companies.

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DEMOLITION OF A CHIMNEY.

By Lieut. D. Ogilvy, R.E.

The following is a short account of the demolition of an old chimney stack near Aberdeen. It had stood for over 60 years, and was considered unsafe though the brickwork appeared sound enough. The contract for the demolition was entrusted to Messrs. Walker & Duncan, of Aberdeen, to whom I am indebted for the facilities of examining the chimney before demolition.

The height of the chimney was 242 feet, and it was built of brick on a granite base, the diameter at the base being 20 feet. The thickness of the brickwork was approximately 2 ft. 3 ins.

The method used to fell the chimney was as follows:—Half the circumference of the base was underpinned with props which were shattered by explosives. No explosives were used in the underpinning process as it was thought that, owing to the age of the chimney, the concussion might cause a premature fall of at least a portion of the brickwork. The props were put in one after the other at given distances apart, the brickwork being pulled down as required. There were 13 props in all, and when they were fixed the intervening brickwork was cut out. So well was this operation carried out, that the chimney only settled $\frac{1}{16}$ of an inch on that side. The props were of larch, and were 9 inches in diameter. They rested upon two hardwood wedges (*Fig.* 2), the top wedge being placed with the butt end outwards, so that if the prop was not entirely shattered, it would be forced outwards and slide off the wedges. The hardwood wedges were placed on pitch pine sills which distributed the weight over as large an area as possible. Caps of the same dimensions (*Fig.* 2), were inserted between the brickwork and the top of the props, and, where necessary, pieces of pitch pine were used as packing pieces.

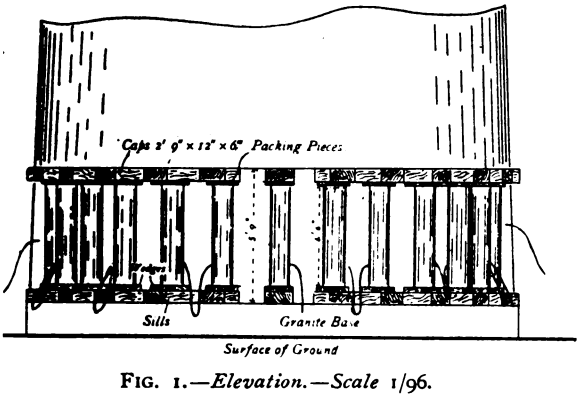

Fig. 1.—*Elevation.—Scale* 1/96.

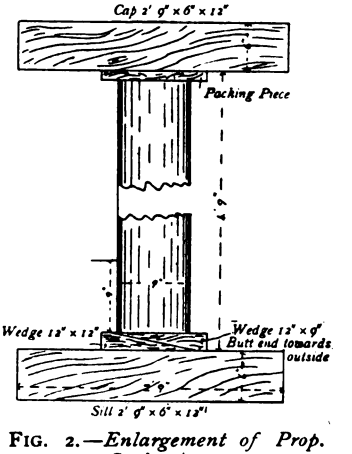

Fig. 2.—*Enlargement of Prop. Scale* 1/24.

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The charge of explosive used for each prop was 3 oz. of gelignite tamped into an auger hole, bored a little less than half-way through, and about 9 inches from the base, on the inside of the prop. The charges were exploded by means of a No. 5 detonator attached to a time fuse. The fuse was regulated to allow of a few seconds elapsing between each explosion, and the centre shot was fired first. In addition to the charge in each prop, two wingholes were bored into the brickwork at each end of the breach (*Fig.* 3). These wingholes were

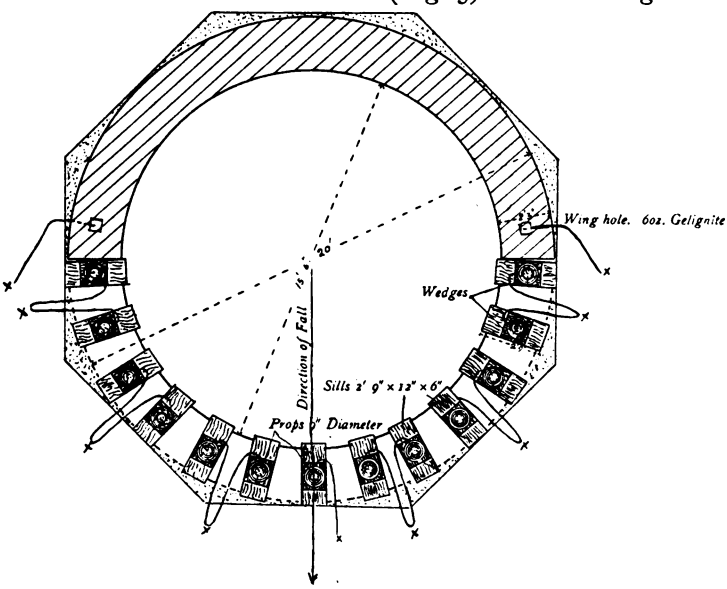

FIG. 3.—*Plan.*—*Scale* 1/96.

charged with 6 oz. of gelignite and the fuse regulated so that they were fired last. The idea of these wingholes was rather far-fetched, the official description stating that the bricks flying from the winghole charges were intended to knock out any prop whose charge should miss fire. The chance of many bricks being displaced by 6 oz. of gelignite in 2 ft. 3 ins. of brickwork was small, but the chance of one of these bricks flying with sufficient accuracy and velocity to knock out a larch prop 9 inches in diameter which was securely wedged under perhaps ¼ of the weight of the chimney was still smaller. However, such was the idea.

An eminent town official was requested to light the fuses. He lit the first one, but—owing possibly to unfamiliarity with this kind of job—he then left. No mishap occurred as this contingency had been foreseen, and the remaining fuses were safely and correctly lighted. The result was eminently successful. When five props had been shattered the chimney swayed slightly. The next two to go caused a slight lean, and almost immediately the stack fell, other explosions being heard amidst the crash of the falling *débris*. The chimney fell as a whole through about 10 degrees, when it broke and seemed to telescope. The fall was almost in the line of the centre prop, and the outside brick was 139 feet from the base when the fall was completed, the whole operation being very successful. An enormous crowd of spectators watched the fall, but luckily there were no casualties.

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AN IMPROVED METHOD OF SIGNALLING.

By MAJOR A. H. D. RIACH, R.E.

CAPT. HAMMOND'S article in the *R.E. Journal* for March, in reviewing our present Service methods of signalling, calls attention to the wide cone of dispersion of lamps and the consequent ease with which messages can be intercepted; while even with the helio, the flash can be read by all and sundry within the limits of the, comparatively, acute angle it covers. The signalling appliance described below is probably little known in the Army, and enables a reflection to be sent from a distant point, back to a single light, the reflection remaining totally invisible outside of a radius of a few feet from the light.

The apparatus consists of a "prism," which can be described as three contiguous sides of a cube, silvered on their inner faces.

Such a prism has the property of reflecting any ray of light, falling on any one of the faces, back along its original path, with a cone of dispersion so small, that the eye has to be placed close up to the source of the ray to enable it to see the reflection.

The writer had the opportunity of testing this. By holding an electric torch close to his eye he could watch its reflection in the prism, which was being violently swung about at the end of a long passage. A spectator looking over his shoulder with his head within 18 inches of the torch could see no reflection whatever.

The size of the prism needed for use up to some miles, is under a cubic foot, and no special means of mounting and direction are required, so that the question of portability does not come in.

To use this for signalling, the prism is provided with a shutter similar to, but larger than, a lamp shutter. With this prism an outpost could signal back information which would reach the principal signalling station only. The only precautions needed, are to see that no lights—other than one steady light at the principal station—are shining into the prism; that this one light is powerful enough to shine brightly for more than double the distance from it to the prism; and that no unauthorized persons are allowed near the light.

For signalling as described above in both directions, the outlying station must have a lamp also, and the principal station a prism.

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Such precautions, however, will not ordinarily be necessary, as they are really required for confidential information, which will normally be sent inwards, and not outwards. Outward orders, if confidential, can be in cypher or sent by hand.

The ability of an advanced party to communicate with the commander, without revealing either its position or its message, is an advantage which it is most desirable to obtain.

Experiments to test not only the practical advantages of the system, but also how to adapt it to the helio as well as to the lamp, are surely well worthy of the consideration of those interested in Army signalling.

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THE MAPS OF GLAREANUS.

By MAJOR-GENERAL E. RENOUARD JAMES, LATE R.E.

FOLLOWING on the Paper by Major Close, R.E., in the June number of the *R.E. Journal*, 1905, the article which appeared in the *Geographical Journal* for the same month, by Mr. Edward Heawood, M.A., on "Glareanus: His Geography and Maps," attracted much attention, and has brought me into correspondence with both America and Germany on the subject of the MS. Latin treatise by Glareanus, and its accompanying series of maps, which are in my possession.

In August, 1905, I had the honour of receiving a visit from a very distinguished student of ancient geography, Professor E. L. Stevenson, of Rutger's College, New Brunswick, which resulted in the maps being reproduced by photography at the British Museum, and I understand it is the intention of the professor to publish the reproductions.

More recently I have been in correspondence with Professor Dr. Walter Ruge, of Leipzic, the learned editor of *Die Literatur zur Geschichte der Erdkunde von Mittelalter an* (1903–7), published in the *Geographischen Jahrbücher* (Gotha). In a recent article by him he gives a brief notice of my Glareanus Manuscript, and, in a letter to me, confirms the opinion expressed by Mr. Heawood, that the treatise is the original handiwork of Glareanus himself and much older than the printed copies which are to be found at Munich, Bonn, and other places. The maps with the MS. treatise were not included in the printed edition, but seem to have a close relation to—if they are not actual reductions from—previously known maps at Schloss-Wolfegg (in Würtemburg), Munich, Bonn, Rome, etc. The arrangement of them in the treatise proves clearly that the text was absolutely contemporaneous with them.

Mr. Heawood gave arguments to prove that the date of the MS. must lie between 1510 and 1520, although I was inclined to think it must be rather later, as some of the maps seem to indicate a knowledge of certain discoveries made in 1520. Mr. Heawood however in a letter to me dated April 1st, 1908, controverts my view, using arguments the soundness of which I am unable to dispute, and I must therefore accept his opinion on the subject.

Dr. Ruge having expressed a wish that greater publicity should be given to the MS. maps, I offer some notes which may help in some

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degree towards this end. In studying the maps analytically it would be of assistance if the unit of map measurement employed by Glareanus was known; but I conceive that it was one in common use at Glarus, his native town, in 1510–20, and most probably was the twelfth part of the Zürich foot, which differs only 0·00012 from the English inch. All the plan-units employed throughout Europe seem to have been based on the Roman foot of 0·966 English foot. For instance:

The ancient Zürich foot	...	...	=0·979	foot,
The same (by another authority)	...		=0·984	,,
The Prague foot	...	...	=0·987	,,
The Nuremburg foot	...	...	=0·997	,,
The Munich foot	...	...	=0·947	,,

and others of almost equal length. We may assume that the early map-makers treated the earth as a perfect sphere, and divided it into 360 degrees of 60 geographical miles, measured both on the equatorial and polar circumferences.

When we begin to examine the maps closely, we at once establish the probability of the use by Glareanus of the Zürich inch, which is practically the same as the English inch, as the unit of measurement.

The authorities consulted by me agree that the first map in the series closely resembles the great Waldseemüller map of 1507 at Schloss Wolfegg, in Würtemburg, though the scale of the latter is about nine times that of the MS. maps with the treatise. It is a map of the whole world, and I venture to describe its projection as a variety of the stereographic method, in which the centres, from which the several parallels are described, are removed in succession further and further along the prolongation of the central meridian. I suppose the map to have been commenced by drawing this meridian as a straight line, and plotting the latitude distances along it. The measurement from the equator to 70 degrees north is exactly 3 inches; and, in the same proportion, 50 degrees south of the equator has a length of $2\frac{1}{7}$ inches, while the 20 degrees at the pole, in nearly half the proportion, is 1 inch. The method, by which the radii of the parallels were determined, is not evident, but they vary from 8 to 9 inches, that of the arc of the equator being 8·75. The equator is only extended to one-fifth the circumference of a circle, the continents of the whole world being inaccurately compressed into this space. As was usual in early maps, the primary meridian passes through the Fortunate Islands (the Canaries), which are $17\frac{1}{2}$ degrees west of the meridian of Greenwich in modern use; the meridian of 90 degrees is in the middle of the map; and the 270-degree meridian limits the map on either side. The eastern and western curves are circular segments with radii of approximately $4\frac{1}{2}$ inches, and the intermediate meridians are equally interspaced

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curves. The initial meridian is carried round the pole in a circular segment to connect with that of 180 degrees. In the central zone of the map this method of projection results in the scale for longitudes being about two-thirds that for latitudes; or, approximately, 2,100 geographical miles to the inch in one direction, and 1,400 in the other.

The second and third maps of the series, which appear to resemble closely the maps by Glareanus at Munich and Bonn—which have been fully described by Professors Etter and Oberhŭmmer—show but little advance on the method of projection of No. 1, except in respect of the abandonment of the idea of mapping the whole world on one plane. They are separate representations of so much of the eastern and western hemispheres respectively as lie between 50 degrees south latitude and the North Pole, bounded as before by the initial meridian through the Fortunate Islands and that of 180 degrees longitude. As with No. 1, the map is commenced by setting off measurements for latitude on the central meridians—90 degrees and 270 degrees—as follows: —For 50 degrees of south latitude, 2 inches *exactly*, and for 70 degrees of north latitude, 3·2 inches. It may be observed here that the intervals between parallels south of the equator are relatively 0·87 of those to the north, which at first sight seems an error in principle, but this I endeavour to give an explanation of further on. As in No. 1, the distance from 70 degrees north to the pole is 1 inch, no attempt being made on either map to represent the arctic region on a correct scale. The centres from which the arcs of parallels are described are, similarly to No. 1, distributed along the prolongation of the central meridian, their radii being approximately—

The equator	...	...	...	9·9 inches.
Parallel 70° N.	...	...	...	6·65 ,,
Parallel 50° S.	...	...	...	8·75 ,,

The arcs of meridians 0 degrees and 180 degrees are true segments of circles, with radii a little over 4 inches, which distance was possibly taken as an approximation to the semi-diameter of the globe; and these meridians are carried round the pole in circular segments, while those of the intermediate meridians are equally-spaced and accurately-drawn curves. This method of projection results in an inaccurate degree-net except in the European zones, where the scale of the maps is approximately 1,100 geographical miles to the inch; in the equatorial zone the latitudinal seems to exceed the longitudinal scale in the proportion of 5 to 4; but in the southern latitudes the constant increases in the intervals between the meridians (before referred to) tend to restore the relation to equality in some degree.

The fourth and fifth maps of the series are similar to the fan-shaped map of Ruysch of 1508, produced in the edition of Ptolemy published

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at Rome in that year, and of which there are copies in the library of the Royal Geographical Society. They jointly represent the whole world from the North Pole to 50 degrees south latitude, the projection of each hemisphere being on three-fifths of a semi-circle. The parallels are segments of concentric circles equally spaced, and the meridians radiate in straight lines from the pole. The measurements along the equator seem to be on a scale of about 1,000 geographical miles to the inch; and from the equator towards the north the longitudinal measurements are in correct proportion to the latitudinal, but south of the equator their apparent length is continuously and wrongly increased. But as the latitude measurements are uniform, the construction of a table of corrections applicable to the southern longitudes would not be difficult. As far as their projection goes, these two maps are not altogether bad.

The sixth and seventh maps in the series are equi-metrical circumpolar projections of the Northern and Southern Hemispheres, similar to those at Bonn of 1510. The meridians are straight lines radiating from the poles, and the parallels are concentric circles. As the semi-diameter of the globe on these maps measures 3·6 inches, the scale along the meridians was probably intended to be 1,500 geographical miles to the inch; and making the best of this method of projection, the longitudinal scale of one part would be not quite 1,000 miles to the inch. But as the variations in proportion are constant, the projection may on the whole be regarded as the most correct of those employed by Glareanus.

Up to this point the geography of Glareanus has not been touched on. No doubt he intended to summarize the knowledge of geography in his day, but we can see at a glance that his maps can have no pretension to accuracy. But, with geographical knowledge and practical navigation in the low condition in which they were at the commencement of the 16th century, accurate systems of projection were relatively of small importance. Such maps were probably only intended to be general and descriptive, and each master-mariner would make, for his own use, sectional maps of the coasts of the countries explored, and would most likely keep his information exclusively secret as long as it was in his power to do so. These general maps did little more than denote the chief points of departure from which new destinations could be reached, by using sailing directions compiled from the experience of mariners. The first stage of the very long distant voyages to Africa and the eastern seas was as far as the Fortunate Islands, which took from 15 to 30 days from Lisbon or Cadiz, according to the force and direction of the wind. The details of this part of the voyage became thoroughly well known in very early times, and the Fortunate Islands were adopted as the principal point of departure from which further distances were measured in all long voyages. For a long period they were thought

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to be the most westerly land, and the primary meridian was made to run through them. Methods of navigation were very primitive. Latitudes were calculated from altitudes of sun and stars obtained with the astrolabe, a very inexact instrument, which was not materially improved upon until the introduction of Davis's quadrant about 1600. The magnetic needle was a very ancient device for showing the direction of the north, but the first practical mariner's compass we read of was not in use until the voyage of Columbus in 1492; while the first compass suspended on "gymbals"—the forerunner of our beautiful modern instruments—was not invented until 1608. We do not hear of the "Log" until 1577 (although we may be in error on this point), and the first published treatise on navigation was not issued until 1545. The essential principle by which longitudes could be determined lay evidently in differences of time, but methods of ascertaining such differences with even a small degree of accuracy depended on the most untrustworthy observations. The first portable clock is said to have been made in 1530, and it was not until the reward offered by the Board of Longitude was awarded to John Harrison in 1764, that any instrument approaching reliability as a chronometer was used by English sailors. The rates of the very rough timekeepers used by the early navigators varied with such terrible irregularity that they could not be depended on for the determination of differences of longitude. Lastly, nautical almanacs were not published until 1767, and mariners, until that date, had to depend on manuscript tables, compiled by themselves, giving the daily right ascension and declination of stars.

The ships of the beginning of the 16th century were bad sailers except before the wind, and their drift to leeward was so great when any attempt was made to progress against adverse gales, that a master-mariner scarcely dared to quit a port except the wind was favourable. Using such sailing direction as he could obtain, he steered by the sun and a few well-known stars until he had reason to consider he had made good a definite distance in the desired direction. If it be true that the log was not used until 1577, the position he had gained must have been little more than a guess calculated from the various courses run, making allowances for the strength of the wind and the estimated speed of the ship, after corrections had been made for leeway and the supposed effects of tides and currents. The positions thus approximately ascertained would be corrected from time to time by solar and sideral measurements made with the astrolabe, but this would be only for latitude; and the longitude would remain a bare estimation, as the daily rates of the timepieces varied so irregularly, that the results they afforded were less to be depended on than those determined by pure dead reckoning. It is true that a number of timepieces might be compared, but the constant possibility of a sudden change of rate occurring with the best

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reputed instrument—a contingency which the ship's motion in rough weather made always likely—introduced a source of error which frequently arose. It was quite impossible to carry time from port to port with any measure of truth, and it was necessary for ships to rest in ports, the positions of which had been previously determined more or less accurately, in order to rate the timepieces before making new departures. Taking all these difficulties into consideration, the comparative inaccuracy of the maps of 1510–20 cannot be wondered at, and it was only by slow degrees that comparisons between the reports of navigators permitted of fairly correct charts being drawn.

The Portuguese were the principal explorers in the eastern seas. Taking departure from the Fortunates, or from the Cape de Verde Islands, with a fair wind from north-west, they relied on striking the African coast somewhere, and the coast line would then be followed closely. Thus Cape Palmas was reached in 1446, and the Gold Coast in 1461. Keeping within sight of land by day, but standing off for safety at night, the voyage was continued southward without much skill in the navigator's art. In this slow way Sierra Leone was discovered in 1462, Angola in 1484, and the whole of the west coast of Africa, when the Cape of Good Hope was reached, in 1487. In 1498 Vasco da Gama doubled the Cape and discovered the Indian Sea, exploring the east coast of Africa as far as Mozambique. Navigation now began to improve, and mariners became bolder in crossing wide ocean spaces instead of hugging the land, and on attempts being made to reach the Cape of Good Hope in a direct course, the islands of Ascension and St. Helena were discovered in 1501. Adventurers also began to explore in the direction of the far east. The maps of Glareanus show that a curious error was made in fixing the position of Zanzibar, which had been visited by Vasca da Gama in 1498, and no doubt he left the notes of his voyage to enable it to be found again. But some strange mistake must have been made in the reckonings, for Zanzibar is marked to the south of Madagascar with an incredible error of 29 degrees of latitude and 48 degrees of longitude. Madagascar, Ceylon, and Malabar were visited in 1505 and 1506, Muscat in 1507, Java, Malacca, and the Moluccas about 1511.

The discovery of the New World had been made before these dates. After the existence of seas to the eastward ot the Cape of Good Hope became evident in 1487, every doubt which remained that the earth was round was dispelled, and Christopher Columbus was inspired with the theory that the quickest way to reach far eastern lands would be by steering due west from Europe, without the smallest idea that he would discover an entirely new continent in doing so. He gained the Bahamas and Cuba in 1492, Jamaica in 1494, the main continent at Florida in 1498, and Honduras in 1502. Cabot, a Frenchman, discovered the Labrador coast, far to the north,

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in 1497; and Amerigo Vespucci, an Italian, reached Brazil and Venezuela in 1499. The general name given to the newly-discovered continent was, at first, "Terra Sancta Crucis," but, after the appearance of Walseemüller's and Ruysch's maps, it came to be known as "America," though the priority of discovery must be credited to Columbus.

The Pacific Ocean was first entered from the east by crossing the isthmus of Darien in 1513, and seven years later it was reached by sea by Magellan, who, passing through the straits which bear his name in 1520, commenced the exploration of the west coast of South America. In making this passage he succeeded in avoiding the dangerous voyage round the south cape, which was made in 1615, when it was discovered by Schouten, a Dutchman, who named it Cape Horn, after his native town.

I supposed at first that the earliest date which could be assigned to the treatise of Glareanus would be subsequent to Magellan's discovery, but, as I have already stated, Mr. Heawood controverts this idea conclusively. It appears that the geographer took his information from maps known with certainty to be of previous date to Magellan's voyage, and that the outline of the South American continent was only a fairly accurate surmise of its form, based on theories formed from the discoveries which had been made.

The maps prove in several ways the geographer's complete ignorance of details, as they show, firstly, that he was still unaware that there was not an open sea passage through the centre of the new continent; and, secondly, because of his omission to mark the straits through which Magellan passed. We do not find on the maps the names of places discovered later than 1520, and even within this limit they are very inaccurate. This is noticeable from the very commencement of the records, for the Fortunate Islands, the chief point of departure, are marked with an error of 14 degrees of latitude. Cape Palmas, on the west coast of Africa, is given errors of 4 degrees of longitude and 14 degrees of latitude. At the mouth of the Niger, which mariners reached by coasting, and where they usually stayed long enough to correct the latitude and obtain the local time, the error was less; but after the whole west coast of Africa was explored, the maps, from which Glareanus copied, marked the position of the south point of the Cape of Good Hope with the almost incredible errors of 15½ degrees of latitude and 6 degrees of longitude.

Ages before the exploration of the eastern seas by Vasco da Gama and other navigators, the vaguest outlines of the coasts of Africa and Asia had been derived from ancient coasting voyages down the Red Sea, which had penetrated to Mozambique in one direction and the Ganges in the other. The marches of Alexander the Great, and, later, the wanderings of Marco Polo and other travellers, had also afforded some knowledge of the continent of Asia. The records,

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such as they were, were absolutely unscientific, but the map-makers who, early in the 16th century, endeavoured to mark the new discoveries were unwilling to reject the old outlines, and in attempting to fit the new and the old together exercised extraordinary imagination. Some lands, apparently intended for Ceylon, Malabar, Malacca, the Moluccas, the Indian peninsula, the Bay of the Ganges, etc., are absolutely misplaced. And in attempting to show the position of islands previously unknown, the error is even greater; for instance, Java Major (which is apparently Borneo) and Java Minor (Java) are each marked 83 degrees of longitude in error.

In examining the earliest conception of the discoveries in the New World, in the making of which the map-makers were not hampered by having to piece old and new outlines together, we seem to see that the various renderings of the coast lines on the different maps from which Glareanus copied were principally based in each separate case on one only of the rival navigators' voyages. In the first map, for instance, it would appear that his authority—Waldseemüller—had obtained his information from the writings of Amerigo Vespucci, and knew nothing of the discoveries of Columbus; for, while an outline is given of the eastern coast of South America, and the name "America" is written, the Bahamas, Cuba, and Jamaica are not even marked. The longitude of the eastern point of South America is marked almost correctly, but the latitude is 7 degrees in error. On this map the position of the west coast of America is only guessed at by an indeterminate line.

In the construction of the third map geographical knowledge seems to have been a little more advanced. The coast of South America is shown as before, but the approximate positions of the islands discovered by Columbus also appear. As before, the position of the easternmost point of South America is fairly correct.

Passing to the fourth map, the information Glareanus had about the continent marked *Terra Sancta Crucis sive Novus Mundus*, seems to have been derived entirely from the work of Amerigo Vespucci, but the map is curiously inaccurate. The east cape of South America has errors of 3 degrees of longitude and 4 degrees of latitude; and it is curious that the marking of the most eastern land of Asia overlaps that of the longitude of Venezuela by 50 degrees, and is actually 107 degrees in error. By this anomaly we recognize that the positions for Asia were determined by navigators coming from the Cape of Good Hope, while those for America were based on the observations of mariners who came westward from Europe. This strange error was corrected after the Pacific Ocean was entered, and the globe circumnavigated from the east; but the first conception of America was that it lay almost wholly to the south of the equator, it being obstinately maintained for a long time that an open ocean separated Europe from Asia.

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In the sixth and seventh maps we see the latest information which had reached Glareanus about the New World, but being confronted with an almost entire absence of names upon them, we can only test the accuracy of the points which seem intended to indicate the new discoveries by comparing the outlines with modern atlases. The islands meant apparently for the Bahamas are marked 6 degrees of latitude in error; Cuba is 3 degrees of latitude in error, and 5½ degrees of longitude; Surinam is 7 degrees of longitude and 1 degree of latitude in error; Venezuela 12½ degrees of longitude and 4 degrees of latitude in error. The position of the eastern cape of South America, however, which we may suppose to have been fixed by comparing the determinations of a great number of mariners, is more accurately given than any newly-discovered land in either hemisphere in the whole series of maps. Notwithstanding the inaccuracy of the positions fixed for the Bahamas, Cuba, etc., the determinations of newly-discovered lands in the New World compare favourably with those of places in the eastern seas, from which it may reasonably be concluded that the science of navigation made more rapid advances with the voyages of Columbus, Cabot, and Vespucci, who dared to remain out of sight of land for weeks at a time, than it ever would have done from the work of the landhuggers, who never ventured far from the coast.

In the construction of the sixth map, when information of the discoveries of Magellan had not yet come to Europe, the marking of the south and west of America was mere guess work, although it is evident that sound theories were formed by the geographers of the time. We need not, therefore, be surprised at the southern cape of America being shown 6 degrees too far to the north, and the longitude 14½ degrees too far east, or that the supposititious west coast, at the latitude of the tropic of Capricorn, has an error of 2½ degrees of longitude.

The printed copy of Glareanus' treatise in the library of the Royal Geographical Society, which is apparently not a first edition, is dated 1533, but contains a dedicatory epistle addressed to Don Joannes à Lasco, dated 1529. After carefully comparing it with the manuscript there is no reason to doubt the priority of the latter. The 40 chapters which each contains are identical in wording, with the exception that the numerous annotations on the margins of the manuscript are embodied in the printed text. The descriptions of countries in the Old World seem to be derived almost wholly from the books of Ptolemy, and to this part of the treatise I will refer briefly only. On the continent of Asia many names are marked by Glareanus to indicate the position of places known to the ancients by those they still bear. I allude to such as Armenia, Arabia, Mesopotamia, Persia, the Red Sea, the Persian Gulf, the Indus and Ganges rivers, etc. But as these do not enter into the history of the 16th century

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discoveries, they need not be further noticed, and for the same reason no further mention is necessary of similar names in Europe and Central Africa. A little more may, however, be said of many names in the treatise and on the maps which have become obsolete, and the positions of which are now rather difficult to identify. Glareanus speaks of two Indies, and marks them *India cis Gangem* and *India trans Gangem;* these divisions are evidently Hindostan and Burmah, neither of which names are given by him. Nor is China named by him, although he gives the ancient *Cathay*, and he marks the positions of *Tibet* and *India Superior* at the extreme east of the Asiatic continent. Other obsolete names are the *Parapanisades*, in the position of Bokhara and Kashmir; the region of *Sinarum*, the name apparently given to the countries near the mouths of the Irawaddy; *Scythia* and *Serica*, for Western and Eastern Siberia; and *Aria*, *Drangiana*, *Arachosia*, and *Gedrosia*, in the position of the countries of Afghanistan, Beluchistan, and on the area lying between the Persian Gulf and the Indus river, both of which are marked on the maps. The outlines of the coasts of Asia, based on ancient knowledge, are marked with extreme inaccuracy, but on all the maps we find *Sinus Gangeticus*, the Bay of the Ganges, and *Sinus Magnus*, possibly intended for the Gulf of Moulmein. In the essay, islands referred to as the *Taprobani Islands* are described as "opposite the Indian coasts," and named on the maps, and these may have been intended for Ceylon, while in the distant eastern seas the *Zipangri Islands* seem to be the Japanese group. In these notes the obsolete names have been distinguished by italics.

The quaint descriptions of the countries of the world in the essay, are evidently based on the books of Ptolemy and the records of old travellers, but all mention of the new discoveries is omitted until the 40th chapter is reached. Only two pages are devoted to regions not known by Ptolemy. We are disappointed that we cannot learn anything about the new world to which Columbus and Vespucci led their crews, for the story of their discoveries is limited to one short paragraph. It is evident from this that Glareanus was not in possession of any precise information by means of which he could define the newly-found countries, with any degree of accuracy, on the maps.

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THE S.M.E. WORKSHOPS.

By LIEUT.-COLONEL B. R. WARD, R.E.

THE S.M.E. Workshops were originally started about 1870 or 1871 by Colonel Leahy, when Instructor in Fortification. Their primary object was to supply profiling battens, mining cases, etc., for field-work purposes, but Colonel Leahy undertook a contract for supplying arm bands and shoes for rifle racks in barrack rooms. These he cut out of old ships' timbers broken up in Chatham Dockyard, and with the proceeds of the contract he constructed a building on the site of the present machine shop, in which he did a good deal of work for the C.R.E. Somewhere about this time Messrs. Aveling & Porter commenced the manufacture of their road engines, and these steam sappers—as they were then generally called—were utilized by Colonel Leahy as stationary engines. In addition to doing work for the C.R.E., the workshops were also of use in testing men at their trades. Previous to their being started, some recruits—known as "Miners"—were enlisted as labourers, receiving only the lowest rate of working pay; others were enlisted as tradesmen, and, as such, had to be tested at their trades in civilian shops, or in the headquarters of the C.R.E.'s.

The development of the workshops was very gradual. About 1872 the first machine shop was constructed by Colonel Leahy. The foundry, the line of shops along the eastern and southern sides of the inner workshops square, and the police quarters were built between 1872 and 1884, and in 1883–84 the office, officers' workshop, and some extra stores in the outer square were put in chiefly by convict and recruit labour. Between 1884 and 1905 little was done to them, but since the latter date a thorough reconstruction has been sanctioned. An earlier expansion of the buildings and plant would doubtless have taken place, had it not been for the possibility of the removal of the S.M.E. from Chatham in 1903 and 1904. As soon as this proposal was definitely abandoned, funds were allotted for an extensive scheme of re-appropriation, reconstruction, and re-equipment, which is being carried out at the present time. The principal features of this scheme are described below.

The old sand model shed, used by the Fortification School, has been re-appropriated as a joiners' shop, a new shed being built in the main ditch for purposes of instruction in fieldworks. New class-rooms, drawing and clerks' offices, lavatory, etc., are being constructed out of the old stores shed; a new steel-frame north-light

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machine shop has been erected on the site of the old turnery; the smithy and plumbers' shops have been re-modelled; heavy roads have been made for mechanical transport traffic. A modern equipment of plant has been purchased and erected in the saw mill, the forge, and smithy, and in the machine shop electric power is supplied from the new Electrical School for lighting and power purposes.

The primary *rôle* of the workshops is:—To instruct officers in the economics and management of workshops and prime movers; to train field engine-drivers, wood-working mechanists, and mechanical draughtsmen; to afford practical instruction in building trades to N.C.O.'s selected for India, to infantry pioneers, and to a class of Marines; and, lastly, to test recruits in their trades.

In order that the staff and plant may be kept at full load with a view to affording better instruction and of reducing the cost of instruction, Part II., *Engineer Services*—such as the provision of joinery for other stations—are undertaken with civilian labour. Further, the mechanical transport and drivers under instruction are utilized to a large extent to assist the transport department and reduce the cost of hired transport.

The first Officer in Charge of Workshops was Lieut. G. R. Walker, who was employed from 1873 to 1878. This title was held by all the officers in charge of the workshops until 1884. In 1888 the workshops were made independent of the Fortification School, and were placed under the Assistant Commandant.

In 1904 the officer in charge was given the title of "Superintendent of Workshops," and was graded as an instructor. Since 1901 an assistant to the officer in charge of workshops has been allowed, Lieut. I. J. Connor occupying the appointment till 1907, when he was succeeded by Lieut. F. D. Hammond.

For many years the training of Sappers in locomotive work, and instruction in locomotive driving for the young officers, formed part of the workshops course, and a short *résumé* therefore of the development of military railway engineering at the S.M.E. will not be out of place.

The first railway ever used for military purposes was one of 4-foot 8½-inch—or standard—gauge, and this was laid in 1855 from Balaklava to the plateau on which the siege works were constructed during the Crimean War. Although this line was laid by a civilian contractor, the introduction of trench tramways as part of the regular work of the Corps in siege operations, afterwards led to the study by the R.E. of steam and locomotive engineering generally.

In 1870 or 1871 a railway of 1-foot 6-inch gauge was constructed in Black Lion Field and down to the Dockyard wall—where the Admiral's quarters are now situated. This trench tramway was used for the conveyance of fieldwork stores from the R.E. Park—now known as the S.M.E. Workshops—to the various batteries, parallels, and other

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siege works which were constantly being constructed in Black Lion Field and the neighbourhood. A line was also laid at Upnor to take steam sapper locomotives running on flanged wheels. This was the origin of the training of Sappers in locomotive work. The Upnor Railway was used for the conveyance of building materials from Upnor to Chattenden, for the construction of the magazines then being built by the C.R.E. at that place.

About 1880 the Upnor-Chattenden Railway (standard gauge) was supplied with a locomotive engine known as "The Royal Engineer," built by Messrs. Manning & Wardle, of Leeds. The line about this time was extended to Hoo, for the completion of Hoo Fort. It thus formed a training ground for the engine-drivers of the 8th Company, which was the first railway company formed in the Corps, and which was sent to Egypt in 1882, under the command of Capt. D. A. Scott, R.E., being employed during the campaign on the railway from Ismailia to Cairo.

While the company was being trained for the Nile Campaign of 1884, Capt. G. F. Wilson and Lieut. W. S. Vidal laid out the alignment of the existing 2-foot 6-inch gauge railway from Upnor Hard to Chattenden and Lodge Hill. The platelaying was executed under the direction of Capt. H. W. Renny-Tailyour. The line was subsequently—in 1907—handed over to the Admiralty, since which date all practical work in connection with railways has been carried out at Longmoor Camp, the headquarters of the railway companies of the Corps.

The following officers have been in charge of the S.M.E. Workshops since Colonel Leahy originated the work in 1870 or 1871 :—

OFFICERS IN CHARGE OF WORKSHOPS.

Lieut. G. R. Walker	1873-1878
„ R. M. Hyslop	1878-1880
„ H. W. Renny-Tailyour ...	1880-1881
„ D. A. Scott	1881-1882
„ H. H. Barnet	1882-1883
„ H. Whistler Smith	1883
„ J. A. Ferrier	1883-1884

ASSISTANT INSTRUCTORS FOR WORKSHOPS.

Capt. H. W. Renny-Tailyour... ...	1884-1888
Lieut. J. Winn	1888-1893
„ H. F. Gaynor	1893-1899
Capt. H. G. de Lotbinière	1899
Lieut. F. E. Harward	1899-1900
Capt. J. N. C. Kennedy	1900-1904

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SUPERINTENDENTS OF WORKSHOPS.

Capt. J. N. C. Kennedy	...	...	1904-1906
Capt. J. W. S. Sewell ...	...	...	1906-

ASSISTANT INSTRUCTORS.

Lieut. I. J. Connor	...	...	1901-1907
Lieut. F. D. Hammond	...	...	1907-

ERRATA

In last month's article on The First Mounted Units of the Corps:—

Page 100, line 4, *for* "Chatham" *read* "Woolwich."

Page 100, line 9, *for* "Chatham" *read* "Woolwich and Chatham."

Page 100, line 35, *for* "when it was first organized" *read* "soon after its first organization."

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TRANSCRIPTS.

ORGANIZATION OF THE MILITARY ENGINEERS IN FRANCE.*

Translated from the *Boletín del Ministerio de Guerra y Marina*, Lima, March, 1907.

A.—DUTIES OF THE ENGINEERS.

THE mission of the engineers is to facilitate the fire and movements of the different arms, and to hinder the fire and movements of the enemy.

The power of the engineers resides, above all, in their tools and materials.

The engineers are charged with the following duties :—

(1). Permanent and semi-permanent fortification.
(2). Attack and defence of fortresses, as well as reconnaissances connected therewith.
(3). Fieldworks, as well as reconnaissances connected with them with the execution of which they may be entrusted.
(4). Bridging.
(5). Communications, their construction, repair, and demolition.
(6). Railways, their repair and demolition, and, when necessary, working.
(7). Ballooning.
(8). Pigeon post.
(9). Telegraphy.

There is an important point which must be insisted on, namely, that the weak establishment of the engineer troops—about 800 per army corps—only permits of the sappers carrying out works of importance, such as the opening up of important communications, the making of large demolitions, and the placing in a state of defence of those points of support which have to offer a particularly long resistance. All works of minor importance must be executed by the troops that have to make use of them.

B.—ENGINEER TROOPS.

1. IN PEACE TIME.

In time of peace one battalion of engineers is in principle attached to each army corps, and bears the same number as that corps.

These battalions however are not stationed (except in the case of the covering troops) in the districts occupied by the army corps to which they are attached. In order to facilitate and simplify their instruction, which requires vast drill grounds and a varied *matériel*, the battalions have been

* A lecture delivered at the Peruvian Staff College by Lieut.-Colonel D. Gastón Hébert.

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grouped in threes and fours, so as to form six regiments of sappers and miners.

The covering troops however require that their units shall always be ready to take the field from the earliest moment of mobilization. In order to attain this result, three battalions and certain detached companies have been located in the frontier garrisons. A few fortresses also possess one company of fortress engineers each.

These six regiments with the three detached battalions form 20 battalions of sappers and miners. The sappers and miners are also pontoniers.

To these 20 battalions must be added:—

(1). 3 battalions of railway engineers, forming 1 regiment.
(2). 1 battalion of telegraphists, organized in 6 companies.
(3). 1 aeronautical battalion, with 4 companies.
(4). 1 battalion of sappers and miners of 7 companies, stationed in Tunis and Algeria.

In each regiment there also exists one company of engineer drivers, for the transport of important *matériel.**

The engineers receive a general training identical with that of the infantry, but their special technical training is as follows:—

(1). In the regiments and battalions of sappers and miners and in the detached companies, all the men are trained in fieldworks, sapping and mining, elementary bridging, demolitions by means of explosives, and in the erection of portable bridges. Afterwards one part (miners) are specially trained in mining, and another (pontoniers) in bridging on some river with a rapid current (the Rhone or Seine†).

(2). The regiment of railway engineers is occupied solely in the laying, maintenance, and working of railways, the erection of portable metal bridges, the repair of large viaducts that have been destroyed, and in various works connected with communications.

The companies are detached, each in their turn, for duty on the great lines of railway, in order to perfect themselves in railway work.

Besides this, the state has entrusted the working of a certain line and junction to a detachment of this regiment. One captain acts as manager, and the lieutenants carry out the duties of inspectors or station-masters at large stations; the sergeants are the station-masters at the smaller stations, the corporals act as guards, and the sappers perform the other duties connected with the working of the line.

On various occasions sappers have to perform work analogous to that which would be required of them in time of war; an example of this occurred at the time of the great review which was witnessed by the Czar of Russia.

* *Note by the Translator.*—The detached battalions are quartered in Verdun, Besançon, and Toul. The six regiments are concentrated at the following places:—1st Regiment, Versailles; 2nd Regiment, Montpelier; 3rd Regiment, Arras; 4th Regiment, Grenoble; 5th Regiment (railways), Versailles; 6th Regiment, Angers; 7th Regiment, Avignon. 20 squadrons of train are attached to these regiments. There are also 21 battalions of the territorial army available in time of war.

† *Note by the Translator.*—The pontoniers are trained by the 6th and 7th Regiments at Angers on the Loire and at Avignon on the Rhone.

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(3). The telegraph battalion is employed in visual signalling, ordinary telegraphy, and wireless telegraphy. The men are trained in the care of telegraphic material, in the construction of lines, and in their working. They are also in charge of the telegraphic communications in fortresses.

(4). The aeronautical battalion is engaged in ballooning, in the repair of material, and in the loading of the balloon wagons. The officers make free ascents.

(5). The pigeon service is a dependency of the aeronautical battalion. The sappers are chosen from those men who have kept carrier pigeons in civil life, and are employed in the care and training of the pigeons. They are stationed in fortresses.

2. IN TIME OF WAR.

On mobilization the company becomes the engineer unit, as regiments and battalions exist only for the purpose of facilitating instruction.

In each battalion the companies are attached in the following manner:—

Battalion attached to an army corps, bearing the same number.	Nos. 1 and 2 Companies become divisional companies, attached to the divisions of the army corps.
	No. 3 Company becomes the corps troops company.
	No. 4 Company becomes either a fortress company or, in the case of an army corps with three divisions, a divisional company.

In the field the engineer units are distributed as under.

A. Division of Infantry.

1 divisional engineer company with its park.

Officers (1 captain, 3 lieutenants or sub-lieutenants) ...	4
Sappers	240
Sapper drivers	11
Horses	28
Vehicles	5

B. Army Corps.

(1). 2 or 3 divisional companies.

(2). 1 corps troops company with 5 officers and park.

(3). 1 corps engineer park with—

Captains	1
Sappers	46
Sapper drivers	185
Horses	303
Vehicles	47

These units are under the orders of the commanding engineer, who is a general of brigade or colonel.

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C. Army.

(1). The units attached to the army corps.
(2). 1 aeronautical company with its park.
(3). 1 army engineer park with—

Field officer	1
Sappers	25
Sapper drivers	271
Horses	449
Vehicles	71

(4). 1 telegraph company with 50 vehicles.
(5). 1 lines-of-communication company.

D. Group of Armies, or Army Operating Separately.

(1). The units attached to the armies.
(2). Railway companies with their park.

E. Isolated Division.

(1). 1 engineer company with park.
(2). 1 divisional engineer park.
(3). Half a bridging train.

F. Fortresses.

In certain fortresses there are engineer, fortress, and balloon companies.

G. Cavalry Division.

An engineer captain is attached to the staff of each cavalry division, and he may have placed under his orders all the sappers of the cavalry regiments of the division.

H. Detachments of Sappers, Cyclists.

These, under the orders of a lieutenant, are attached to certain cavalry divisions. They carry on their bicycles the tools and explosives necessary for making demolitions or effecting repairs in front of the army.

SOURCE OF SUPPLY OF ENGINEER OFFICERS.

Engineer officers are obtained in the following ways:—

(1). From students who have qualified at the École Polytechnique. These are graded as sub-lieutenants on passing out, and have then to serve for one year in that rank in a regiment of engineers, before going through a course of instruction for one year in the École d'Application at Fontainebleau.

(2). From those non-commissioned officers of engineers who have passed the examination at the conclusion of a year's course at military school at Versailles. A certain number of officers of this class attend the courses at the school at Fontainebleau.

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(3). In order to fill vacancies on the establishment caused by the sending of engineer officers to the colonies for fortification, public works, and railway duties, a certain number of non-commissioned officers of artillery, cavalry, and infantry are allowed to take part in the examination for admission to the military school at Versailles.

RESERVE OF OFFICERS.

The greater part of the reserve officers belong to the *Ponts et Chaussées*. Others are either retired officers of the corps, or non-commissioned officers of engineers who have passed the required examination.

Engineer officers are attached either to units of the corps, or to the staff for engineer services.

STAFF FOR ENGINEER SERVICES.

The staff for engineer services is charged with the construction and maintenance of fortifications and barracks, of certain communications in fortified places, and finally with all questions relating to war department property.

France is divided into a certain number of engineer districts, whose headquarters are at the principal city of the district, or at the headquarters of army corps, or in important fortresses. At the head of each district is a colonel or lieutenant-colonel, called the director of engineers.

The districts are divided into divisions, commanded, according to their importance, by lieutenant-colonels, majors, or captains, called chefs de génie, who carry out their works by means of engineer captains, or—under exceptional circumstances—of administrative officers (officiers d'administration), who are placed under their orders.

Proposals for works are approved, according to circumstances, either by the director of engineers, the general commanding the engineers, or the minister of war.

The director of engineers performs the duties of secondary auditor, in the verification of the accounts of the sums expended on works.

Officers of engineers are assisted in their duties by administrative officers (officers of the administration of engineer services), by barrack wardens, and by *portiers-consigne*.

The administrative officers are recruited solely from the N.C.O. students of the École d'Administration Militaire at Versailles (engineer section), who have passed the final examination.

The engineer administrative officers number 570, and have a separate organization; their relative rank is as under:—

Officier d'administration,	3rd class	... ...	Sub-lieutenant.
,, ,,	2nd ,,	... ...	Lieutenant.
,, ,,	1st ,,	... ...	Captain.
,, ,,	Principal	... ...	Major.

They are charged with the superintendence of the works and with financial duties connected therewith.

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The *portiers-consigne* have the relative rank of adjutant (N.C.O.), and are charged with the care of fortifications and barracks. They are recruited from amongst non-commissioned officers of various arms of the service after having passed an examination. They are commissioned.

The barrack wardens are charged specially with the maintenance of barracks. They are recruited from among non-commissioned officers of various arms of the service who have passed an examination, and receive a proportionate rate of retired pay. The office of barrack warden is considered as a civil one.

The administrative officers of the reserve and of the territorial army, are recruited from amongst retired officers of the same class, and also to a still greater extent from sub-engineers and conductors of the *Ponts et Chaussées*.

Engineer Establishments.

Besides the districts and divisions, there exist a number of engineer establishments intended to carry out particular services, viz. :—

(1). The technical engineer section, which studies questions submitted to the technical committee of the corps.

(2). The directorate of military telegraphy and engineer war *matériel*, which has under its orders :—

(*a*). The general military telegraph depôt, which constructs, buys, experiments with, and takes charge of all *matériel*.

(*b*). The commission of studies and central establishment for engineer war *matériel*, charged with experiments relative to the improvement, construction, and provision of war *matériel*.

(3). The aeronautical laboratory.

(4). The central aeronautical establishment, charged with the construction of aeronautical *matériel*.

(5). The military pigeon lofts.

(6). The engineer schools established in the localities in which engineer regiments and detached battalions are quartered.

These establishments have as their objects :—

(*a*). To afford to these units of the corps the means of securing the special instruction of the non-commissioned officers and sappers.

(*b*). To take care of the *matériel* of the engineer parks, the *personnel* of which mobilizes in the garrison in which the school is situated.

(*c*). To prepare non-commissioned officer candidates for the grade of administrative officer, etc.

The school connected with the 5th Regiment is called the Railway School. It is charged with the maintenance of the railway park and portable bridge *matériel*.

The importance of these establishments, which have as their object, in almost every case, the construction and maintenance of *matériel*, cannot be denied, when the very large quantity of vehicles. tools, machinery, and *matériel* required for the different units of the armies are considered.

For example :—

(*a*). The bridge train of a French army corps is composed of 47 vehicles.

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(*b*). The heavy Rhine bridge train (German) is composed of 119 vehicles.

(*c*). A Roumanian pontonier company has 53 vehicles.

(*d*). A field balloon company in France has 17 vehicles.

(*e*). A German engineer siege train has 59 vehicles.

HIGHER COMMAND OF THE ENGINEERS.

In Peace Time.

In those districts in which engineer troops are stationed the command is held by a general officer. In other districts the command of the engineers is entrusted to the colonel, director of engineers.

In time of war the engineers of an army corps are commanded by a general officer or colonel; the engineers of an army are commanded by a general.

At the principal points on the lines of communications, lines of communications engineer divisions are established, commanded by reserve officers, under the orders of the commanding engineer of the lines of communications.

RÔLE OF THE ENGINEERS IN THE COLONIES.

Engineer colonial troops have not been raised. When a colonial expedition takes place engineer units are formed either from volunteers or from men selected by lot.

The part which these troops play in colonial expeditions is considerable. Very varied and difficult tasks are entrusted to them, such as the construction of piers for the disembarkation of the force, hutting, the making of roads, railways, bridges, etc.

Outside the active operations of a colonial campaign, engineer officers are charged with the making of roads, railways, and harbours in unhealthy climates and amongst hostile inhabitants.

In this way important works have been carried out by engineer officers in Madagascar, Senegal, French Guinea, the Ivory Coast, Dahomey, the Congo, Tonkin, and Cochin China.

The maximum number of engineer officers who may be seconded for the execution of colonial works is fixed by ministerial decision of the 23rd February, 1901, at—

Colonel and lieutenant-colonel	2
Majors	5
Captains	23
Lieutenants and sub-lieutenants	10
Administrative officers	20

'M.'

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THE USE OF SANDBAGS AS COVER IN THE ATTACK.

Translation of an article appearing in the *Mitteilungen über Gegenstände des Artillerie-und Geniewesens* No. 4 of 1908, and kindly forwarded by the General Staff, War Office.

SINCE the conclusion of the Russo-Japanese War, various experiments have been made, not only in Russia, but also in other countries, in the use of sandbags for purposes of cover during the attack. In the course of the war the Japanese frequently made use of sandbags, not only when acting on the defensive but also when attacking, and this fact has attracted the attention of all armies to the point in question.

While these experiments have been carried out on a varying scale in other armies and the matter has then been allowed to drop, greater importance seems to be attached to the question in Russia, where experiments are still being continued.

The first to point out the desirability of such experiments was General Skugarevski, President of the Committee on the training of the Russian Army. In consequence of his representations, exhaustive experiments have been (and are still being) carried out by various Russian regiments, and reports have been furnished to the committee referred to. The result is that the use of sandbags in action would seem to have been adopted as the normal rule in the *Drill Regulations and Tactical Instructions for Infantry*—now being prepared by this committee—as well as in the new *Manual of Field Fortification.*

The *Militär Wochenblatt* No. 158 of December, 1907, published an interesting notice of an article by the commander of a Russian battalion, which originally appeared in the *Russki Invalid* No. 235, dealing with the results of the experiments as far as they have gone.

It may be gathered from the original Russian article, that the troops did not take to the experiments in the use of sandbags with any more enthusiasm than they did to other forms of earthwork. The reason for this is said to be the disasters of the recent war, in which, notwithstanding the most extensive use of the spade, elaborate cover and fortifications did not save the army from defeat, and the faith of the men in the efficacy of work—which was always disliked—was badly shaken.

The experiments mentioned by the Russian battalion commander in his article were intended to clear up the following points :—

1. What is the thickness of cover required, and the amount and description of earth necessary for filling the sandbags?
2. What is the best colour for sandbags, with a view to their being as little conspicuous as possible?
3. How should sandbags be used in action—especially in the attack?
4. Should the sandbag be introduced as an article of the men's equipment, and if so in what form?

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With regard to 1 and 2, experiments were carried out during the course of musketry training. At 400 paces* two head-targets were used, of which one was covered by a sandbag; another practice was carried out at the same range with one head-target covered by a sandbag; and finally at 600 paces and 400 paces with two head-targets covered by sandbags, and two similar targets without such cover.

The sandbags used were made of canvas of a grey-green colour, about 19½ inches long (the breadth of a man's shoulders), and 12—14 inches in breadth and depth. The weight of the sandbag when filled varied from about 30 lbs. to 44 lbs., according to what it was filled with (sand, gravel, or rubble). When filled with sand and gravel the sandbag was not penetrated by bullets, whereas when filled with earth even two sandbags placed one behind the other did not afford any adequate protection. In the practice carried out at 600 paces, the sandbags could hardly be detected with the naked eye, and the target behind a sandbag was extremely difficult to see. Even at 400 paces, with one head-target behind a sandbag, the difficulty of aiming was greatly increased.

With regard to point 3—the use of sandbags in action—the question of their use in the defence was not touched upon, as their enormous importance in defensive action had been sufficiently proved in the course of the recent war, especially during the winter fighting in the positions on the Sha Ho. There is also no question that the use of sandbags in the attack will be avoided in ordinary average ground. On the other hand, in very open ground their use is of incalculable value. The men dislike making fire-trenches when lying down, as digging or scraping the ground in that position is most inconvenient. They feel that it is much more to the purpose to fire than to laboriously dig a hole for themselves, especially as they are expecting every moment to have to dash forward. The idea that the reserves coming up behind will use and improve such trenches usually remains (as the experience of the last war proves) a pious hope and nothing more. It is preferable for the reserves to make a longer advance, and to utilize even an unimportant fold in the ground, rather than undertake spadework under the enemy's fire. Moreover, though such fire-trenches may afford cover from view to a man lying down, the earth thrown up does not stop a bullet. When the ground is hard, work with the small entrenching implement while lying down, is at best unsatisfactory and fatiguing, and is often quite impossible.

In the experiments carried out, empty sandbags were carried by the men and were not filled until the last moment, *i.e.*, immediately before deployment into attack formation. They were then filled with whatever soil was available on the spot. At ranges between 2,200 and 1,100 yards, the advance was carried out by individual men making short rushes of 30—40 yards, as the sandbag, when filled, is a considerable weight for a running man to carry. Before the rush the rifle was "slung," and the neck of the sandbag was grasped by one hand, while the other hand seized a special loop made for the purpose; the man then ran forward as

* A Russian pace = 2·329 feet.

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fast as he could some 30—40 yards, threw himself down, and took cover behind his sandbag.

Under effective fire from the enemy, between 1,100—600 yards, creeping forward under cover of the sandbags was practised, and it was found in some of the practices, that the men preferred creeping forward considerable distances with filled sandbags, to entrenching themselves while lying down.

From the defender's position it was impossible to detect, with the naked eye, a man lying down behind a grey-green sandbag, at ranges between 2,200 and 1,100 yards. The battalion commander mentions in his article that both officers and men were at first very averse to the experiments, but after two or three practices they entirely changed their opinions. Any misgivings as to increasing the field equipment carried by the soldier was more than compensated for by the undoubted advantages of the sandbag.

With reference to 4, the question whether the sandbag should be adopted as an article of the soldier's equipment and if so in what shape, it was proposed to take the opportunity of the issue of new field equipment regulations, to reduce the weight at present carried by a few ounces, in order to make the addition of a sandbag possible. It was not considered desirable that the sandbags should be carried with the first line transport.

As to the material to be used for filling the sandbags, the writer of the article points out that there can be no dearth of suitable material available in European countries, amply provided as they are with good roads.

The *Militär Wochenblatt* adds that the introduction of the sandbag as part of the soldier's equipment, is entirely out of the question in Germany, since its use in offensive tactics must be confined to exceptional occasions; it would diminish the men's activity in attack and cripple the offensive spirit.

The provision of a larger number of sandbags in the wagons of the engineers, for use in the preparation of defensive positions, and also in the engineer siege trains, for use in siege operations, where sandbags are of especial importance to the attacker, has been arranged for by regulations quite apart from the questions discussed in the article referred to above.

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REVIEW.

FIELD ENGINEERING IN VON LÖBELL'S ANNUAL FOR 1907.

THE thirty-fourth volume of von Löbell's *Jahresberichte über das Heer und Kriegswesen* has been issued in the usual form:—It contains reports on the armies of the various countries; on the tactics of infantry, cavalry, field artillery, and the combined arms; on fortification, field engineering, transport, balloons, telegraphy, small arms, artillery *matériel*, military history, etc., etc. Like the previous numbers, it has within its covers a mass of military information and statistics not to be found in any other single work.

The following is a summary of the article on field engineering:—

The first section—Field Fortification—gives a summary of the opinions which have appeared in print during the year. It is claimed that the German *Manual of Field Fortification*, 1893, was the first in which complicated works were abandoned, which taught that cover should be as low as possible, bombproofs as numerous as possible, and parapets as invisible as possible, and insisted that it was the duty of every arm to learn, and be master of, the use of fieldworks.* The Russo-Japanese War has proved that the German theories were right, but there are still some commanders who are "spade-shy," and who say "rather double in heavy marching order; it takes less breath than grubbing along the ground." This is no doubt the right spirit, but infantry should know how to use the spade, for necessity may force them to employ it, even as it drove the Japanese.

The new *Manual of Field Fortification*, 1906 (reviewed in the *R.E. Journal* of January, 1907), has still further simplified the art, and has still further laid stress on important principles. There is now little difference between the manuals of the various armies, but the French one admits *positions de repli* behind the main line, while the German lays down "one line only" as a general principle.

The proper tactical use of fieldworks is all-important, and much instruction may be gained in this subject from the great engineer exercises carried out in conjunction wtth other arms. The sentence from *Infantry Training* which is placed at the commencement of the *Manual of Field Fortification*, "Defence that will not only repulse an attack, but will include a decisive victory, must be carried out on offensive lines," is in accord with Clausewitz's idea, "The art of entrenching should not be used by

* Here, as so often happens in German works, complete ignorance of British military text books and writings is exhibited.

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the defender in order to fight with greater safety as behind a wall, but to attack the enemy with better chance of success." A strong position can be held by a comparatively weak garrison, and so will free reserves for use elsewhere.

The Japanese never delayed entrenching as soon as they had occupied a position; the Russians were often slow, and commenced to dig so late that their working parties frequently betrayed the situation of the trenches and rendered measures of concealment of little use.

Although "advanced positions" are rarely desirable, "advanced posts" must be regarded as an essential feature of every position; such posts compel the enemy to an early deployment, and are often able to provide useful flank fire; they should be strongly fortified, but weakly garrisoned, and able to hold out during the attack on the main position.

There is considerable difference of opinion in military literature as to the value of obstacles, due to some extent perhaps to the remark in the *Manual of Field Fortification*, "Strong natural obstacles, and continuous lines of artificial obstacles on a front, hinder an advance, and may induce the enemy to turn it." Some writers hold that it is vain to expect to be able to make a frontal counterstroke; it offers too many disadvantages—First, it is to be presumed that a numerically superior enemy has to be attacked; secondly, all fire effect must be renounced during movement; and thirdly, neighbouring sections will not be able to fire while their comrades are in front of the position.

Generally a clear field of fire is held preferable to obstacles, but a cleared field of fire may very possibly betray the position, and this must be considered in the arrangements ordered.

One writer on field fortification—Stavenhagen—has drawn a curious deduction from the instruction in the German Manual, viz., "that fire effect is all-important; therefore the first work to be undertaken is clearing the foreground and measuring ranges. Cover is the second consideration." He thinks the clearing and measuring are to be completed, and "then only is cover to be constructed in the shortest time possible." This is not what is meant; it is intended that the commander should regard clearing a field of fire as of the first importance, but he is not to delay undertaking other necessary work at once.

Another writer, Woelki, contends that the official principle, "fire effect before cover," is wrong, and points out that a clear field of fire, unless the defender is well covered, may give great advantage to the attacker.

Fritsch, in his work, *The Attack of Fortified Positions*, deals specially with the *rôle* to be played by the engineers in combination with other troops. In 1866 and 1870–1 such co-operation was generally lacking; in peace the engineers have too often been regarded as isolated units not really forming part of a division or corps, and very superfluous at manœuvres; so that they have not had opportunity of learning how to appear at the right time and place, and the commanders have not been accustomed to reckon on their assistance. A considerable advance has, however, been made, and it is now recognized that engineers are indispensable in the destruction of obstacles, the reconnaissance of a position, the preparation of stores for an assault, the construction of the assault

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position, and in the assault itself. There should be at least two companies of engineers per division; the Japanese had three, and found that number insufficient, for they had to call for volunteers for engineer duties from the infantry.

Special attention is drawn to an article in the *Revue du Genie Militaire* of July, 1907, which gives an account of the sapping and mining done by a Russian sapper company against a Japanese field position on the Sha Ho.

The second section of the article deals with bridging. It is stated that the Russian pontoniers, though expert at pontooning, were found during the Manchurian War to be insufficiently experienced in building temporary bridges. In future the heavy artillery of the field army will make special demands on bridge builders. Attention is particularly drawn to the *Manual of Temporary Bridges*.

Austria has adapted the Hébert *matériel* for the cavalry bridge train; each regiment carries with it in eight four-horse wagons *matériel* for a bridge 35 mètres (114·8 feet) long.

In France the experiments with a light cavalry *matériel* are not yet concluded.

The third section deals with organization. The compiler, recalling the controversies of past years with regard to the increase of the engineers, is glad to be able to record a fact—one engineer battalion has been added to the German Army, but it will not be the only one.

A short *résumé* of the growth of the Prussian engineers is given. In the war of 1864 all the nine engineer companies were employed; in 1866 all the companies were again used, but only five pontoon trains and six light bridge trains; the 1st and 2nd Armies had to build or repair 110 bridges mostly with extemporized *matériel*. Owing to lack of mutual understanding between the staff and the engineers, the latter were hardly used in the battles, and were prominent only on the lines of communication. After the war the 4th—or miner companies—of the engineer battalions were converted into fortress companies; the 2nd and 3rd Companies (sappers) were given increased instruction in bridging; and with the 1st Companies (bridgers) were given some instruction in mining. In 1870–1, although all the field companies and 30 out of the 33 fortress companies were employed in the war, there was an insufficiency of field engineers; yet after the war all three field companies of a battalion were trained as pontoniers. In 1885, the 4th Companies dropped mining and were trained as field companies. It was arranged that certain engineer companies should be raised as siege companies, but when the 16th Battalion—which was to be the nucleus of these companies—was formed, it was trained as a field battalion.

In Austria, where the Engineer Corps (as separate from the field battalions) was reduced in 1893, and in France, when the pontoon train was disbanded and its duties handed over to the engineer troops in 1894, Germany's lead in introducing the "one pattern" engineer units (*Einheitspioniere*) was followed. Although many officers protested in these countries, the authorities appeared to consider that future wars must be wars of manœuvre, and that technical troops would only be

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required on the communications. It took the Russo-Japanese War to open their eyes to the possibilities of the attack of fortifications and positions. In Germany the number of battalions had been gradually increased, so that in 1901 there were in all three battalions more than the total number of army corps. In 1905 it was decided to raise one battalion in each of the years 1907, 1908, and 1909, and in six army corps to have a regiment of two battalions instead of a single battalion; the second battalion in each regiment is to devote special attention to siege warfare. All battalions will be fully instructed in field warfare and temporary bridging, but those which do not specialize in fieldworks will be trained as pontoniers. The objections to the separate training have at last been overcome. In this connection it may be remembered that many generals opposed the formation of separate telegraph companies, yet these now must be subdivided to provide wireless companies, and increased from three battalions of three companies each to three battalions of four companies each.

Several new technical inventions have appeared which may develop into matters of extreme importance, such as liquid air as an explosive, the respirator Vanginot with compressed air, with the breathing apparatus "Aerolith of Suess und Schumann."

The organization of the Military Technical Academy is now completed; the two junior courses are no more and no less than the two divisions of the old Artillery and Engineer School under a new name. All officers without exception attend the "Pioneer Course" and the so-called "First Engineer Course"; then they go back to regimental duty, and, later on, a few of them are selected for the Second and Third Engineer Courses. This is simply a return to the former system of sending a few officers to the Technical High School for special technical instruction, except that the new course is more adapted to military requirement.

The article concludes with list of books and articles of military interest which have appeared during 1907.

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NOTICE OF MAGAZINE.

REVUE DU GÉNIE MILITAIRE.

May, 1908.

MILITARY TELEGRAPHS.—The French first used the electric telegraph for military purposes in the Crimea in 1854, and in 1862 some further experiments were made with it at Chalons. The first telegraph company was raised in 1868, and on the outbreak of war in 1870 this was still the only telegraph company that France possessed. Various other telegraph units were raised during the war.

After the close of the war in 1872, the reorganization of the military telegraphs was taken in hand, and in 1875 the whole of the military telegraphs were handed over to the civil telegraph department at the request of the latter. Very soon however the civil department began to complain of the burden of their military duties, and the war department were called upon to furnish not only the telegraph stores, but also a considerable *personnel* for the military telegraphs. This system was expensive and inefficient.

In 1900 another reorganization took place, and a telegraph battalion was raised to take over the first line military telegraphs. The line-of-communication telegraphs were left in the hands of the civil telegraph department.

The telegraph companies are army troops. They are entrusted with visual signalling as well as telegraphs. Each company is organized in six sections, and commanded by a captain, with another captain as second in command. The sections are commanded by subalterns, of whom five-sixths belong to the reserve. The *personnel* for the second line telegraphs is taken from the civil telegraph department. One telegraph company is allotted to each army. Each cavalry division has also a telegraph section, commanded by a reserve lieutenant. In every cavalry regiment there are four telegraphists, and these on mobilization form the divisional telegraph section. Each cavalry regiment also furnishes one telephone and two kilomètres of wire, carried on the saddles of the telegraphists. Each cavalry brigade has telegraph instruments and a few kilomètres of wire, carried in a light cart.

The writer makes various suggestions for the improvement of the existing organization, of which the following are the most important:— Each army corps should have a telegraph section allotted to it. The telegraph companies are too large to be commanded by one officer; it would therefore be better to form each company of three sections instead

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of six, and to double the number of companies. The telegraph troops of each army should then be placed under the command of a senior engineer officer. Each telegraph section should be organized and equipped as a self-contained unit.

THE FOREIGN MILITARY ESTABLISHMENTS IN CHINA.—A continuation of the previous article. A description is given of the German barracks at Tientsin. The German troops were originally quartered in hired European houses, in the Chinese University building, and in some portable barracks of the Decker type. The buildings now in occupation are the Chinese University, and some portable wooden barracks erected behind it.

The writer also gives a description of the English barracks in the Pekin Legations. The troops were originally quartered in some old Chinese yamens, but the heavy roofs of these buildings showed signs of collapsing, and they had to be pulled down. Barracks for 250 men are now being built to replace them. The design of the hospital—which was nearly finished at the time of writing—is commended. The Legation defences consist of a brick wall 3 feet thick, with small bastions for flanking it. The writer considers that the wall is not a sufficient defence, as the Chinese have plenty of modern guns which they could bring to bear on it.—*To be continued.*

J. E. E. CRASTER.

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RECENT PUBLICATIONS OF MILITARY INTEREST.

JULY, 1908.

(*Published Quarterly*).

THE following extracts from the list compiled by the General Staff, War Office, are published in the *R.E. Journal* by permission of the Army Council.

HISTORICAL.

THE TRUTH ABOUT PORT ARTHUR. By E. K. Nojine. Translated and edited by Capt. A. B. Lindsay and Major E. D. Swinton. 395 pp. 8vo. London, 1908. Murray. 15s.

This work gives a vivid picture of the situation inside the fortress, from the opening of the war until the capitulation, including the fighting at Nanshan and in the mountains between Dalny and Port Arthur. The author is a civilian, and during the siege was correspondent of the *Novy Kry*, the Port Arthur newspaper, but although he has been at great pains to collect information, he is such a hot partisan of General Smirnoff, and so violently antagonistic to General Stessel, that his statements must be accepted with caution. He left Port Arthur in a destroyer on November 15th, so that the facts were not altogether gathered by personal observation. Nevertheless, documents are quoted to an extent which makes it impossible to doubt the correctness of most of the accusations levelled at General Stessel, and at the trial of that officer the indictment was almost a repetition of the charges contained in this book.

From a military point of view the work will perhaps be found a little disappointing, but as a graphic narrative by eye-witnesses of the principal events which led to the capitulation it will be found of absorbing interest.

An excellent map of the defences is given, and there are several good illustrations reproduced from photographs of the defence works.

THE RUSSO-JAPANESE WAR (La Guerre Russo-Japonaise). By Colonel E. Bujac. 487 pp., 21 maps and sketches in text. 8vo. Paris, 1908. Lavauzelle. 6s. 3d.

This work is the sixth of a series written by the author and entitled "Précis de quelques guerres contemporaines."

It is divided into five parts.

Part I. opens with a retrospect of the political situation, from the treaty of Shimonoseki to the outbreak of the Russo-Japanese War, and contains a description of the theatre of war and of the contending armies.

Part II. comprises a history of the struggle up to the establishment of army head-quarters in Manchuria under Marshal Oyama. It treats of the naval operations off Korea, round Port Arthur and in the sea of Japan. The narrative of the campaign on land embraces the Battles of the Yalu and Nanshan.

In Part III. the author describes Oku's and Kuroki's advance towards Liao-yang, the Battles of Liao-yang, the Sha-ho and Hei-ku-tai, the siege operations up to the capture of the 203-mètre height inclusive, Mishchenko's raid on Ying-kou and the "dashes" southward attempted by the same general in February and May, 1905, as well as the Japanese cavalry raids against the Russian communications.

Part IV. contains an account of the fall of Port Arthur, the Battles of Mukden and Tsushima, and the expedition to Saghalien.

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Part V. gives a history of the peace negotiations and the events immediately succeeding the cessation of hostilities. The renewal of the Anglo-Japanese Alliance is also noticed and discussed.

The details given in Part I. concerning the Trans-Siberian Railway are of interest, and a useful table of distances between different points on the Russian and Chinese railway systems is given. Data are furnished concerning the traffic which passed over these systems at different periods, and the *personnel* and *matériel* carried.

Next follows a concise strategical summary of the war—an arrangement whereby the student is enabled to grasp the general course of the campaign before proceeding to study its details.

The measures taken to ensure China's neutrality are next discussed, as are also international law questions relating to contraband of war, right of search, anchoring in neutral waters, floating mines, disposal of wounded in naval warfare, and wireless telegraphy.

A list of Chinese prefixes and suffixes, descriptive of administrative divisions and topographical features is given. The *précis* of the successive steps whereby demobilization was accomplished shows the difficulties attending the process. The criticisms of the three arms on the Russian side on pages 55—58 are too superficial to be of value; in discussing the infantry, the author quotes largely from a lecture by Capt. Soloviev published in Vol. L., *J.U.S.I.* The gist of the above is the important part played by the bayonet attack, and the need for more officers.

This part of the book contains several errors. The nine brigades of East Siberian Rifles, alluded to on page 33, contain *four regiments of two battalions*, and not *two battalions* as stated. The raising of third battalions for these rifle regiments, referred to on page 35, was *not* part of the mobilization. The figure 95,000 on page 36 is considerably underestimated. On page 59 it is stated that Manchuria and the adjoining regions were the *only* base of provisions, whereas in reality nearly all flour, vegetables, condiments, and oats were at first brought from Europe.

On the other hand, the details given about the Japanese forces, which even include the names of and changes amongst chief staff officers and regimental commanders, are wonderfully accurate.

The statement on page 81 that the 1st Reserve Brigade was sent from the IInd to the IIIrd Army at the end of August, 1904, is, however, an error. This brigade served with the IIIrd Army from the beginning of July, 1904. From data supplied, the author reckons the total loss of the Russians during the war at 280,000. Admissions to Russian hospitals were 18·8 per cent., and the proportion of killed to wounded was $\frac{1}{3\cdot5}$.

In discussing Japanese infantry tactics the author remarks on the following:—

(*a*). The large number of rifles employed at the outset in order to obtain superiority of fire, resulting in an undue extension of front and premature using up of reserves.

(*b*). The practice of entrenching during the attack.

(*c*). The use of rushes, which according to the author tended to be long in the Ist Army and short in the IInd and IVth Armies.

(*d*). All commanders—especially generals—keep their places, and great attention is paid to intercommunication, with happy results.

The general characteristics of Japanese tactics are said to be:—

Approach to hostile positions by night when possible.

Close co-operation of infantry and artillery. Energetic attack of selected points—often at night or dawn.

The details given on page 88 concerning infantry ammunition supply do not take account of the increased number of rounds carried during the later stages of the war.

Losses in horseflesh during the South African and Manchurian campaigns are compared, and also losses through disease in the Japan-China and Russo-Japanese Wars respectively. Japan's total losses during the latter war are given as 450,000. Some statistics are given to show what heavy financial burdens the war imposed upon Japan.

In Part II. the difficulties of modern blockade, the employment of torpedoes and mines, and the action of war vessels against land defences are briefly discussed.

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In criticizing the Battle of the Yalu, the author, after quoting from various military writers, gives the opinion that Sassulitch would have been well advised to retire without giving battle, but that having at the last moment decided to accept it, he adopted the worst methods of defence under the circumstances, viz., the cordon system. Reconnoitring detachments should have been pushed well forward and different points along the river guarded by advanced posts—carefully interconnected—thus giving the main body time to manœuvre; the main body to attack the enemy whilst the latter was in the act of crossing.

The following points in the Russian disposition are criticized:—

1. Two complete regiments held back far behind the right.
2. The absence of reserves and cavalry on the left.
3. The absence of a general reserve and second position.
4. The orders for the occupation of the position.

Some interesting observations follow regarding the treatment of correspondents in this war and their position nowadays; the latest German regulations on this subject are quoted.

The description of Oku's movements between his disembarkation and the Battle of Nanshan is meagre.

Regarding Nanshan, the Russians are criticized for failing to keep large reserves at hand and omitting to make a counter-attack on the 4th Japanese Division. The absence of a Japanese naval force in Hand Bay is commented on, but is rightly attributed to the dread of mines.

Stakelberg is criticized for fighting at Telissu according to a preconceived plan, and for his tardy and piecemeal use of reserves. Contrary to some authorities, the author considers that the Russian commander was well served by his cavalry.

In a discussion on the conduct of the campaign by the Japanese up to the eve of Liao-yang, their strategy is warmly defended against various critics whom the author quotes (see also comments on strategy, page 244).

Oyama's preliminary dispositions at Liao-yang are praised, but they "finally end in a commonplace frontal attack." The force for the frontal attack "Japanese left and centre" is pronounced as too strong, and the right (Kuroki) as too weak, for its tactical task, the indispensable preliminary of its strategical *rôle*.

Kuropatkin's best plan, according to the author, would have been a vigorous offensive with the right wing, with a reserve behind his left to prepare for eventualities.

Pages 273—277 contain an excellent description of the Japanese infantry attack.

In the chapters dealing with Port Arthur full particulars are given as to the strength of the garrison, food and ammunition supplies, etc. Several opinions are quoted as to the surrender. The differences between General Stessel and some of the higher commanders are referred to, but evidently the author was ignorant of much that has lately come to light, since Fock is referred to in a footnote as a "heroic figure." The statement that the Russians successfully countermined under Fort No. II. (page 312) is incorrect, and in the last paragraph, on page 311, *19th* Regiment should read *12th* Regiment. On page 380, General Samejima is erroneously stated to have been transferred from the command of the 7th to that of the 11th Division; he never commanded the former.

Of Port Arthur the author says that it only had a deceptive likeness to a fortress, that neither attack nor defence were up to modern standards, and that the instructiveness of the siege was consequently affected.

The defence is held to have used its reserves up prematurely in defending too extended a perimeter. The premature assaults of the Japanese are blamed, and attention is drawn to the inability of the Japanese artillery to perform the three-fold task of keeping down the adversary's artillery fire, sweeping the ground and opening up "storming avenues" for its infantry.

General v. Caemmerer's criticisms on Mukden are quoted, and extracts are given from other writers descriptive of Japanese attack formations (both by day and night) at this battle.

The book is not well edited; Chinese, Japanese, and Russian renderings of names are used indiscriminately both in the text and on the maps, and different transliterations given of the same word where only one language is used.

On page 24, the 10th Division is described as the nucleus of the IIIrd instead of the

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IVth Army. The words "Army" and "Corps" are used indiscriminately in describing Japanese forces consisting of several divisions.

On page 80, "Jobihei," which includes the standing Army and its 1st Reserve, is erroneously translated as "armée active." On page 144, Sasaki's Brigade is stated to include the 17th instead of the 47th Regiment.

In spite of these imperfections the book is a most valuable aid to the study of the latest great campaign, especially as a preliminary to the perusal of larger works.

HISTORY OF THE WAR IN SOUTH AFRICA, 1899—1902. Compiled by the direction of His Majesty's Government. Vol. III. 560 pp., with maps in separate case. 4to. London, 1908. Hurst & Blackett. 17s. 6d. to subscribers and 21s. to non-subscribers.

Vol. II. of this history was noticed on page 3, No. 3.

The present volume opens with an account of the rebellion in N.W. Cape Colony, and of the measures taken for its suppression between October, 1899, and July, 1900.

The remainder of the book deals with the whole of the operations from the reorganization at Bloemfontein in March and April, 1900, till the departure of Lord Roberts from South Africa in November, 1900. It thus includes the advance of Lord Roberts to Pretoria, the operations in the Orange River Colony in May and June, 1900, the siege and defence of Mafeking, Plumer's operations in the north, the Battle of Diamond Hill, Sir R. Buller's operations in Natal up to his junction with Lord Roberts, the surrender of Prinsloo, the advance to Middelburg, the pursuit and escape of De Wet, the advance to Komati Poort and to Pilgrim's Rest, and the operations in Western and Eastern Transvaal and in the Orange River Colony at the end of 1900.

This volume, though not dealing with such important engagements and operations as its predecessors, certainly lacks nothing in the way of interest, and though, like its predecessors, it refrains from comment, adverse or otherwise, it is often possible to read between the lines and to see clearly who was in fault or the reverse, and for what reasons.

A vivid picture is given of the difficulties which beset Lord Roberts at Bloemfontein in March and April, 1900, and of the extraordinary difficulty of supplying, at a later stage, columns widely separated and operating in country, the topographical features of which differed so widely as they did in the Transvaal and the Orange River Colony.

All the operations are described with great clearness, and that this alone is no small achievement will be realized by all who took part in the scattered operations of the latter half of 1900.

By the aid of the excellent maps provided it is possible to follow the operations through every detail, and to realize, to a certain extent, the difficulties which surrounded the commanders, who in many cases were pursuing a mobile and elusive enemy through a little-known country, while they themselves were to a great extent tied to roads and based on railways. The difficulties were those which regular troops operating against a guerilla enemy have always to surmount, and many historical instances could be adduced to show how other nations have had in other countries to contend with similar problems. If the reader turns to Professor Oman's Vol. III. of *The Peninsular War*, he will find many of the conditions repeated, though in many cases the task of the French generals was an easier one than that of our own in 1900.

On the whole, this volume is thoroughly worthy of its theme, and should be read and digested by all officers.

THE DEFENCE OF PARMAIN (La Défense de Parmain). By A.-D. Denise, former Mayor of Parmain. 220 pp. 8vo. Méru, 1906. J. Douce. 1s. 8d.

An interesting story of a little-known episode of the war of 1870-71. Though the author may be suspected of erring on the side of partiality to his own countrymen, the account demonstrates that raw levies, when composed of patriotic and determined men, may check even the best regular troops for a short time; at the same time, however, it affords yet another proof of the inability of these untrained men to act on the offensive or to carry out any concerted action, and shows that their efforts, however brave and heroic, are certain to end in defeat and disaster.

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KÖNIGGRÄTZ. By Lieut.-Colonel H. M. E. Brunker. 112 pp. 8vo. Portsmouth, 1908. Holbrook. 3s. 6d.

This small book is an epitome of the campaign, summarized from Bonnal's *Sadowa* and other authorities.

It is apparently compiled with a view to assisting officers in their examinations for promotion, and, as the author points out, should be taken rather as a guide to further reading on the subject than as a complete history.

The maps provided are not clear, and the difficulty of reading them is enhanced by many variations of spelling of names of places in the text.

The addition of a map of the country about Trautenau and Nachod would have been an improvement.

MILITARY HISTORY FOR EXAMINATIONS IN 1908: QUESTIONS ON THE KÖNIGGRÄTZ CAMPAIGN IN 1866. By Lieut.-Colonel H. M. E. Brunker. 17 pp. 8vo. London, 1908. Forster, Groom. 1s.

This pamphlet contains 50 questions on the campaign of 1866 in Bohemia, the first eight of which are the same as those set at the Staff College Entrance Examinations of August, 1897. The questions are searching and to the point, and would doubtless be of value to students of the campaign.

A HISTORY OF THE CIVIL WAR IN THE UNITED STATES, 1861–5. By W. Birkbeck Wood, M.A., and Lieut.-Colonel J. E. Edmonds, R.E. 549 pp., 13 maps, and 11 plans. 8vo. London, 1908. Methuen. 12s. 6d.

This is a second edition of a book originally published in September, 1905, and is an endeavour to provide "within a reasonable compass an impartial account of the events of the four years of hostilities." Chapter XX., "Grant and Lee in Virginia. From the Wilderness to Cold Harbour," and portions of Chapter XXI., which contains an account of Major-General Butler's operations in May and June, 1864, and of Chapter XXIV., "The Shenandoah Valley in 1864," will be found useful by officers preparing for the November promotion examination; but the volume will be specially of service to those who wish to obtain a general survey of the military operations before proceeding to the detailed study of a particular period.

GRANT'S CAMPAIGN IN VIRGINIA (THE WILDERNESS CAMPAIGN). By Capt. Vaughan Sawyer. 197 pp. 8vo. London, 1908. Swan Sonnenschein. 5s.

This is the eighth volume of the "Special Campaign Series." Opening with a short outline of the war up to the beginning of the special period under consideration, it contains a clear, concise, and impartial account of the operations in Virginia, from the date of Grant's appointment to command of all the armies of the Union (March 9th, 1864) till shortly after the battle at Petersburg in June of the same year.

This book is accompanied by eight maps, which would have been more valuable had the names of all places mentioned in the text been included.

THE CAMPAIGN IN VIRGINIA, MAY AND JUNE, 1864. By T. M. Maguire. 88 pp., 6 maps in black and white. 8vo. London, 1908. Clowes. 4s.

This book consists chiefly of extracts from various works on the campaign in question. Officers are recommended to study the originals rather than the reproduction.

MEMOIRS OF FIELD MARSHAL SIR HENRY W. NORMAN, G.C.B., etc. By Sir W. Lee-Warner, K.C.S.I. 319 pp., with portraits and maps. 8vo. London, 1908. Smith, Elder. 14s.

In the first chapter of this history Sir W. Lee-Warner traces the early career of the late Field Marshal, relating how he entered the Indian Army and joined the 1st Native Infantry, being shortly afterwards finally posted to the 31st Native Infantry (now the 2nd

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Queen's Own Rajput Light Infantry). Sir Henry Norman having become Adjutant of his regiment took part in the Sikh War, and was present at the Battles of Chilianwala and Gujrat; of the former a detailed account is given, the want of a decisive result being ascribed in a large measure to the flight and panic of the cavalry on the right. After the Sikh War, Norman acted as Brigade Major of a punitive expedition sent in 1850 against the Afridis, and his conduct on this occasion earned for him the appointment as Brigade Major at Peshawar.

After taking part in numerous frontier and other expeditions, Norman was finally appointed to the Bengal headquarter staff in May, 1856.

On the outbreak of the Mutiny, Norman was at Simla, but joined General Barnard's staff and acted as A.A.G. at Delhi. His account of the Siege of Delhi is mostly taken from extracts from letters to his wife, and gives a vivid picture of the whole scene and operations. He seems to have been always cheery and sanguine, although the difficulties to be contended against were at times very great. Being on the staff all the time he saw the inside of things, and, therefore, his account is well worth reading, even though the reader may be familiar with the events.

After the taking of Delhi, Norman went with the Lucknow relieving column still as the representative of the Adjutant-General's staff.

The description of the relief of Lucknow is brief, chiefly owing to the fact that Norman could not send many letters to his wife owing to difficulties of communication. After Cawnpore, Norman, having had a few days' leave, joined Sir Colin Campbell for the Oudh Campaign, where he fulfilled the same duties as before.

He then acted as Adjutant-General throughout the operations which ended in the capture of Lucknow. He took part in the operations of 1858, and finally went home at the end of 1859. In September, 1860, he was appointed A.M.S. to the Duke of Cambridge, but in 1861 was recalled to India to assist in the reorganization of the Indian Army, finally becoming Secretary to the Government of India in the military department. He had become Lieut.-Colonel and C.B. for his services in the Mutiny.

From this point Norman became a quasi-civilian, and the remainder of his career, though he filled the important posts of Member of the Council of India, Governor of Jamaica, Governor of Queensland, and finally Governor of Chelsea Hospital, ceases to be of purely military interest, though his views on the subject of our relations with Afghanistan, given in Chapter IX., should be of considerable interest to all soldiers.

The book as a whole presents a striking picture of a man who always did his duty to his utmost ability, and whose career, though latterly passed more as an administrator than as a soldier, may well serve as an example and incentive to all ranks of His Majesty's Service.

A map of India at the time of the Mutiny would have added greatly to the value of the book.

HISTORY OF THE PENINSULAR WAR. By C. Oman. Vol. III. September, 1809—December, 1810.—Ocaña, Cadiz, Bussaco, Torres Vedras. 560 pp., with maps and illustrations. 8vo. Oxford, 1908. Clarendon Press. 14s.

This, the third volume of Professor Oman's history, opens with an outline of the political conditions obtaining in Spain in the latter part of 1809. The next two chapters deal with the operations in Aragon and Catalonia, but chiefly with the Siege of Gerona by Verdier, St. Cyr, and Augereau. The account given is vivid and interesting, and a great deal of information seems to be new. None of the French generals appeared in a favourable light in these operations, the usual jealousies and quarrels which appeared in the absence of Napoleon being evident. On the Spanish side the incapacity and indecision of Blake was balanced by the ability and resolution of Alvarez, whose treatment by the French after the surrender does not redound to their credit.

The autumn campaign of 1809 forms the subject of the next chapter, and the actions of Tamames, Ocaña, and Alba de Tormes are described. The first of these three was a victory for the Spaniards, largely owing to the indifferent generalship of Marchand, who made three weak attempts and was strong nowhere; but Ocaña, where Areizaga was opposed to Soult, resulted in a very severe defeat for the Spaniards, whose cavalry were inefficient and whose general showed a combination of vacillation, hesitation, and rashness which was fatal. He followed no definite plan, and when he had gained a temporary strategical advantage made no attempt to complete it by a tactical success. At Alba de

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Tormes the French victory was due to a tactical mistake on the part of Del Parque, to the indifferent quality of the Spanish troops, and to the dash of Kellermann, the French cavalry leader. The whole campaign is instructive, and although such an operation as Kellermann's at Alba de Tormes can hardly be recommended as an example of cavalry action, yet in general the operations show that victory goes to those leaders who follow the well-established principles of war.

We next come to Section XVIII. ("The Conquest of Andalusia"). The first chapter deals with the general situation, showing how the Spanish Army had fallen into the common error of attempting to guard every passage through an obstacle, with the result of being weak at all points and strong at none. The result of this policy was soon seen in the complete defeat and practical annihilation of the Spanish Army, while Soult and Joseph occupied Cordova and Seville. The French, however, were checked in their attempt on Cadiz, and Joseph returned to Madrid, leaving behind him a garrison of 70,000 troops.

The author now turns his attention to Portugal, and after a comprehensive survey of the geographical features of that country and of the possible routes for an invasion from Spain, he proceeds to consider Wellington's preparations for defence, in connection with which he also treats the subject of the Portuguese Army and administration. The next chapters deal with the French preparations, with the operations of Bonnet in the Asturias, with the siege and capture of Astorga by Junot, with the capture of Ciudad Rodrigo by Ney, and finally with the combat of the Coa and the capture of Almeida by Masséna. In his description of the Coa, Professor Oman pays fitting tribute to the conduct of the Light Division, but blames Craufurd for his action in getting involved in the fight.

The events in Eastern Spain are then related, and the operations of Suchet in Aragon, and of Augereau and Macdonald in Catalonia, are described. The disasters of the Spaniards were frequently due to their lack of cavalry, and though their leaders at times displayed energy and determination, their lack of combination proved generally fatal. The same factors affected the situation in Andalusia, where the only favourable element was the successful defence of Cadiz; but otherwise the Spaniards were everywhere defeated, though they certainly kept Soult and his lieutenants busy.

The next two chapters deal with Masséna's advance to Bussaco, and with the Battle of Bussaco. The descriptions are admirably clear, and with the aid of the excellent maps which illustrate the advance and the battle it is possible to grasp the situation and to understand all the important features of the fight. Mr. Oman challenges Napier's accuracy in several instances, and supports his charges by authentic extracts from various sources. He brings out the fact that there was little or no connection between the attacks of Ney and of Reynier, and also that Reynier's attack consisted of two entirely separate phases. A description of the topography of Bussaco is added, in which the salient features which affected the tactics of the battle are well brought out.

The remaining chapters of this section are devoted to an account of Wellington's retreat to the lines of Torres Vedras, and to a very complete and clear description of the lines themselves. The section concludes with the story of Masséna's retreat to Santarem. The author does not fail to criticize Wellington's dispositions in November, 1810, nor those of Masséna, and considers that both leaders did not act up to their reputations. Here the account of the operations in Portugal in this volume ends.

The last two chapters in the book deal with the operations in the north and east of Spain at the end of 1810, and with the political conditions in Spain generally. Appendices contain details regarding the various forces, orders, etc.

It is hardly necessary to say, considering Professor Oman's reputation, that this work will be of great interest to soldiers. Although a great part of it deals with operations in which the British forces did not take part, yet the interest of British officers should not be diminished, for the lessons of the various operations are well drawn, and the mistakes or successes of the various commanders are clearly pointed out, thus providing that instruction which should be the end and aim of all military history. In addition, there is not a dull page in the book, and it will doubtless be of interest to civilians as well as to soldiers. The maps are good, but the book stands in great need of a general map of the Iberian Peninsula. Some of the maps, too, are inserted in inconvenient places.

It is to be noted that Professor Oman maintains that the generally-used spelling of "Busaco" is wrong, and that it should be spelt Bussaco, as given above.

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THE WAR OF 1809 (Krieg, 1809). Vol. I.—Ratisbon. By Major E. M. von Vedropolje and Capt. O. Criste. 710 pp., with 23 maps. 8vo. Vienna, 1907. Seidel. 30s. Vol. II.—Italy. By Major M. Ritter von Hoen and Capt. A. Veltzé. 507 pp., with 12 maps. 8vo. Vienna, 1908. Seidel. 16s.

This excellent work has been prepared in the military-historical section of the Austro-Hungarian War Archives. It is based upon the original reports, supplemented by information from other authentic sources, and contains an exceptionally detailed account of the campaigns dealt with.

The first volume deals with the operations in Bavaria from the 10th to the 23rd April, 1809. It is divided into four sections. The first (pages 1 to 66) contains a history of the political events which led to the war; the second (pages 67 to 212) deals with the numbers, organization, and general characteristics of the opposing forces, and with their strategic concentrations; the third (pages 213 to 300) with the operations from the 10th to 15th April; and the last (pages 301 to 604) with the operations from the 16th to 23rd April, 1809.

The second volume is devoted to the operations in Italy during April and May, 1809. This volume is similarly divided into four sections. The first (pages 3 to 45) deals with the concentration of the opposing armies; the second (pages 46 to 207) with the Austrian offensive in Italy; the third (pages 208 to 345) with the Archduke John's retreat to the Austrian frontier; and the last (pages 346 to 432) with the fighting in the Carnic and the Julian Alps.

The Appendices (pages 605 to 710, Vol. I., and pages 433 to 507, Vol. II.) contain the text of many important orders and reports, in addition to other valuable information. The maps are excellent.

The book should be of great value to officers studying the campaigns in question.

THE SIEGE OF GENOA, 1800 (Le siège de Gênes). By Eduard Gachot. 448 pp., engravings, plans, and maps. 8vo. Paris, 1908. Plon-Nourit. 6s.

M. Gachot is a well-known authority on this period, and the author of several volumes dealing with it—"The First Campaign in Italy" (1795—1798), "Second Campaign in Italy" (1800), "Suvarov in Italy" (1799), "The Campaign of Helvetia" (1799).

The present work reads more like a prose epic than sober history, and is a record of what may be accomplished by a determined commander with beaten and disheartened troops, despite want of money, food, and supplies, a hostile population, and daily diminishing numbers. It is founded on the documents in the French archives, the papers of Masséna, now in the possession of his descendants, and contemporary letters and diaries, particularly the diary kept during the siege by an Italian nobleman.

When Napoleon became First Consul by the *coup d'état* of the 18 Brumaire, the Army of Italy had ceased to deserve its name. Defeated and driven back, it only occupied Cori, in Piedmont, where the garrison was besieged, and Genoa, with the strip of coast leading to France; its commander, Championnet, had resigned, suggesting that Bonaparte should be sent to succeed him. Masséna was selected by the Consuls to restore the situation, and summoned to Paris from the scene of his successes in Switzerland.

In response to his demands for men, money, and supplies, he could obtain little from Berthier, the Minister of War, except promises; at Lyons and Marseilles, where he expected to find magazines, he discovered but little, and was practically left to make his own arrangements with local contractors.

Arrived at Nice, on the 17th January, 1800, he found the troops were deserting literally by hundreds; that the army had neither money, clothing, guns, ammunition, wagons, horses, nor mules; that the men still with the colours were living by robbery or begging;

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that fever and influenza raged, and that the so-called hospitals were without beds, coverings, wine, medicines, linen, or even warm water (through lack of fuel). The blockade of the coast by the British and Neopolitan fleets, under Lord Keith, made it extremely difficult for supplies, even if available, to be forwarded to the troops.

On 10th February Masséna reached Genoa, where he found mutiny, anarchy, and conspiracy. He at once set about restoring discipline, organizing, requisitioning, and manufacturing. By the 15th March he had formed three corps, under Soult, Suchet, and Turreau, and in spite of his difficulties, was planning the offensive. On the 4th April, however, Mélas, the Austrian commander, commenced a movement against him with threefold more numerous troops, in four columns, by different routes, with the view of cutting him off and surrounding him. Taking advantage of the dispersion of his opponent Masséna was able to hold him off for some little time, and even to take numerous prisoners, but was eventually separated from Suchet and Turreau and isolated at Genoa, on 6th April, with 16,000 men of his force, where he was blockaded on land by 40,000 Austrians, and on sea by Lord Keith's fleet. He had to renounce the offensive and assume the modest *rôle* of defending a fortress.

Hampered by an enormous civil population and without reserves of supplies, the situation soon became a terrible one. By the 15th May the starving population was reduced to devouring "bats, large spiders, lizards . . . grass and seaweed were eaten raw . . . snails and lemon bark commanded high prices. Wood fibre, worms, grasshoppers, cockchafers, and caterpillars were sold when the butchers had no more dogs, cats, or rats to offer. Leather for stewing was sold at 2 francs a pound. The ration of the garrison was reduced to 5 ounces of bread made of beans and hay, 4 ounces of horse, and ½ pint of wine . . . but often the soldier was on half or even quarter rations." The deaths per diem gradually rose in number—315 on the 25th May, 419 on the 28th May, 523 on the 2nd June.

A heavy sortie was made on the 11th May in the hope of capturing a large supply depôt; but it failed, and Soult was wounded and captured. After this there was no active defence.

Napoleon had required Masséna to hold Genoa until the 23rd April. He promised to hold it until the 20th May, but receiving no message by that date, continued the defence.

By the 3rd June eating leather was 14s. a pound. Masséna dined on grass soup and a piece of horse without bread; the Austrian prisoners ate human remains; the garrison was reduced to 4,000 men. Yet in spite of the agonies endured Masséna was not only obeyed, but an officer was able to write of him, "When Masséna marches out the dying raise themselves and try to follow him. To these atheists he has become a god." Famished and sick, his men never ceased to admire a chief who knew how to appeal to their courage and cared for them as if they were his children; but they said, "Masséna will make us eat our boots before he surrenders."

On the night of the 1st—2nd June the Austrians attempted to surprise the fortress, but after the repulse of one detachment the others retired.

On the 2nd June a British naval *parlementaire* proposed a "capitulation," but Masséna would not hear of the word. On the 3rd the Austrian commander, Ott, proposed a *readition;* on the 4th Masséna met Keith and Ott and obtained his own terms:—The French were allowed to march out with arms and baggage, free to recommence hostilities after a truce; the sick and wounded were to be transported by sea to Antibes. The arrival of Napoleon in Northern Italy and the necessity for the instant presence of the Austrian troops elsewhere made hours of value and forced the Allies to grant easy conditions. They would have done better to have raised the siege rather than to negotiate, for without horses, without supplies, and his men invalids, Masséna could not have left Genoa.

On the 24th June the French, in accordance with the terms of the treaty at Alessandria, made after Marengo, were again in possession of Genoa.

An account of the operations of the French left wing and centre, which was separated from Masséna, and of the Siege of Savona is included in the volume.

Although the maps supplied with the work possess a special interest as being photographic reproductions of those used by Masséna, they are somewhat difficult to decipher, and do not appear to contain the names of all the places referred to in the narrative.

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LIFE AND SERVICES OF VISCOUNT LAKE. By Colonel Hugh Pearse. 429 pp. 8vo. London, 1908. Blackwood. 15s.

Lake began his military career at the age of 13, in 1758, in the 1st Regiment of Foot Guards.

Though he took no part in the great victories of 1759—Minden, Quebec, Madras, and Quiberon Bay—he gained early experience of active service in the Seven Years' War, which ended with the fall of Cassel in 1762.

He then had a long period of home service, brought to a close by the outbreak of the War of Independence in America in 1775, when every available fighting man was required. The attitude of the "Opposition," who referred in the House of Commons to any British success as "terrible news," undoubtedly led to the intervention of France and our ultimate loss of America. The result was that England, without an ally, was at war with her Colonies, France, Spain, Holland, and in India, and was further embarrassed by riots in London and in Ireland.

The surrender of Cornwallis at Yorktown in 1781 brought these wars to a close; a surrender directly attributable to the faulty distribution of our fleet, due to an attempt to guard all our possessions simultaneously. This gave de Grasse command of the sea sufficiently long to complete the isolation of the British troops in the Yorktown Peninsula, and to allow the French and American land forces a free hand in the investment of the town.

Lake spent the ensuing period of home service between the dissipations of the Court and the representation of Aylesbury in the House of Commons In 1793, being now a major-general, he accompanied the small British Army which was thrown into Holland to oppose the invasion by the Republican troops. By August the Allies (England, Austria, Prussia, and Holland) were so successful that, but for the dissensions almost inseparable from such coalitions, they might have marched on Paris and restored the Monarchy; but the opportunity was lost. Lake was recalled in 1794 to take up the appointment of colonel of the 53rd Regiment, and in 1796 became major-general on the Staff in Ireland. He was immediately threatened with invasion by 16,000 French troops, but fortunately the weather was rough and the expedition could not land. In 1798 he had a considerable hand in the suppression of the Irish Rebellion, and immediately afterwards marched to Mayo, where Humbert with 1,100 French troops had landed. It is interesting to note that at this period of small sailing ships it was estimated that the French would have had no difficulty in landing 40,000 men on the coast of Ireland. Though he managed to keep the field for 17 days, and was successful at the "Castlebar Races," Humbert eventually surrendered with his whole force. In 1800 Lake was appointed Commander-in-Chief in India, under Wellesley as Governor-General. The Maratha War broke out in 1803, and Lake's part in Wellesley's scheme was the command of the Northern Army; his task was the defeat of the Army of Sindhia, which was based on Agra, Delhi, and Aligarh, and had been organized and trained by Frenchmen, most of whom were dismissed by Sindhia, or quitted his service on the outbreak of war. His own army consisted of 10,000 men, accompanied by no less than 100,000 camp followers. He defeated the French general near Aligarh, stormed that fortress, defeated Bourquin at Delhi, captured Agra, after a short siege, and finally won the important Battle of Laswari, after a march of 65 miles in 48 hours. This, fought just after Assaye, proved the turning point of the campaign, and peace with Sindhia was signed at the end of the year. Holkar, jealous of Sindhia, had remained inactive while his rival suffered the above successive defeats, but early in 1804 he took the field against the British and gained one or two successes against the detachments into which Wellesley had divided his army. Lake's great energy, however, backed up by some wonderful marching by his troops, restored British prestige, and victories near Farakhabad and Dig, and the persevering, though unsuccessful, Siege of Bhartpur, opened the way to an honourable ending of the war. The Court of Directors of the India Office, however, considered this a suitable opportunity to recall Wellesley, who on many occasions had shown more regard for the public weal than for the wishes of "his very worthy masters."

Wellesley sailed for England in August, 1805, and his successor, placing economy before all else, gave Lake orders which amounted to a complete surrender of all gained.

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Lake, however, took upon himself to continue Wellesley's policy, and having temporarily satisfied Sindhia, he finally forced Holkar to accept terms early in 1806.

So disgusted was he with what he termed the "huckstering policy" of the Directors that he would only remain in India long enough to demobilize; early in 1807 he returned to England, and in the following year died after a short illness at the age of 63.

Colonel Pearse is fortunate in his selection of his subject, and his treatment of it has given us a book which is full of interest both from a military and a historical point of view.

The maps to illustrate the campaigns are clear, and contain the names of practically all places mentioned in the text.

THE CAMBRIDGE MODERN HISTORY. Vol. V.—The Age of Louis XIV Edited by A. W. Ward, A. W. Prothero, and S. Leathes. 927 pp. 8vo. Cambridge, 1908. University Press. 16s.

The last volume (IX.) issued of this history was noticed in No. 3, page 7. The volume under review is of considerable military importance, for it deals with all the wars of the latter part of the 17th century, and with those of the first 15 years of the 18th century. It thus comprises the fighting against the Turks in Hungary, the wars of Sweden with Denmark, Charles XII. of Sweden's campaigns, and the wars of the Spanish Succession, including all Marlborough's campaigns. A good many of the more noted battles of European history come within this period—Blenheim, Ramillies, Oudenarde, and Malplaquet; Narva, Dunamünde, Pultusk, and Poltawa; Fehrbellin, Lund, etc., etc. Besides engagements on the Continent of Europe, we have also William III.'s operations against James II. in Ireland, including the Battle of the Boyne, and the sea fights of the Anglo-Dutch wars in 1666, 1672, and 1673. The battles are not generally described in any detail, nor would it be possible to understand them without the aid of battle plans, but the main outlines of the campaigns are generally clearly and carefully shown, though, in this case also, it would have been far easier to understand them had maps of the Europe of that time been provided with this volume.

The writer of the chapter on Marlborough's campaigns ascribes his success chiefly to his knowledge of how to use the three arms, and of how "the combination of all three would increase the efficiency of the whole." In another chapter the success of the Austrians and Germans against the Turks is ascribed to the teaching of Montecuculi, and to the attention which the Germans had given to organization and tactical training, whilst the Turks had stood still. It is interesting to note how Charles XII.'s invasion of Russia failed, principally owing to the Fabian tactics of the Russians, and to the great difficulty which Charles experienced in supplying his army, much the same causes as were responsible for Napoleon's failure. A great part of the volume is naturally given up to the political history of the time, and much of the information therein given must be interesting to the military as well as the civilian student of history. The history of Russia is traced from 1462, and that of Prussia from 500.

The chapter on the early history of the Colonies of European Powers and of Europeans in India will be of particular interest to Englishmen.

Chapters on the literary, religious, and scientific history of the time complete a volume of this history, which will certainly not be found the least interesting of the series.

The very complete bibliography, the chronological table, and the excellent index deserve mention.

A REVIEW OF THE HISTORY OF INFANTRY. By Colonel E. M. Lloyd. 302 pp. 8vo. London, 1908. Longmans, Green. 6s.

This volume carefully traces the development of infantry tactics, formations, and arms, and briefly describes their effect in the more important battles of the world—from Platæa to Mukden.

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POLITICAL.

THE ANGLO-RUSSIAN RIVALRY IN ASIA DURING THE 19TH CENTURY (La rivalité anglo-russe au 19ième siècle en Asie). By Dr. Rouire. 300 pp., with a map. 8vo. Paris, 1908. Colin. 5s. 6d.

The Anglo-Russian Agreement gave rise to so much adverse criticism in this country that it is of great interest to hear a comparatively impartial foreign opinion. The views held on the Continent vary in accordance with the desire of the different nations to see friendly or hostile relations prevail between Great Britain and Russia. The French people welcomed the agreement between their friend and their ally, and were ready and anxious to look upon it in the most favourable light. It is, therefore, only reasonable to expect Dr. Rouire to enter upon his task in an appreciative frame of mind. Although, however, it is fair to admit that his mind may have been prejudiced in favour of the agreement, he has in this volume advanced very cogent arguments in support of his views.

As regards Persia, Dr. Rouire points out that Russia's influence has become paramount in the northern portion of the country, and that Great Britain abandoned no rights or advantages, but merely gave her official assent to a position which she had allowed to arise by her own negligence, a position which she had become powerless to alter in her own favour. Though the Russian sphere of influence undoubtedly includes the richest and most fertile provinces of Persia, Great Britain receives valuable concessions in that she secures an equal share with Russia in the supervision of Persian political affairs and finances, in that Russia has acknowledged her special interests in the Persian Gulf, and has allowed Seistan to pass definitely under British control. Moreover, Russia has renounced all political action in Teheran, has recognized the principle of commercial equality, and has apparently abandoned the idea of gaining access to the sea and acquiring a warm water port.

With regard to Afghanistan, the author is of opinion that Great Britain has gained what she wanted, and that the position of Afghanistan as a buffer State is stronger than ever. In the case of Tibet, he seems to think that Great Britain has been only too glad of a chance of withdrawing from that inhospitable country, now that she has demonstrated her strength to the Tibetans, and has made it certain that no foreign power will be able to establish itself in the land of the Lamas.

On the whole, then, Dr. Rouire is disposed to offer his heartiest congratulations to both parties on settling disputes which had existed for so long, and had so often threatened to bring about war between the two nations, a war the costs and results of which would have been entirely out of proportion to the magnitude of the questions involved. He shows that Great Britain is now free to devote her attention to the Persian Gulf, to Oman, and to Koweit. Whilst mentioning the somewhat anomalous position occupied by France on the Arabian coast, he emphasizes the great importance of Koweit, and advises Great Britain to concentrate her energies on the acquisition and maintenance of this place, the future terminus of the Baghdad railway and the key of the new route to India.

The whole tendency of the book is to rejoice that the two principal friends of France have become reconciled, so that their strength and that of France herself are thereby increased and have become free for use against their real enemies, who are rapidly growing more dangerous and more intent on mischief. The author believes that Russia and Great Britain have no serious reason to quarrel in Asia, and is glad to see that they have at last recognized this fact, and have realized that it is high time for them to concentrate their strength in order to deal with their true enemies.

The book is interesting and well written; there are a few inaccuracies, *e.g.*, Sikhs are described as being "either Hindus or Mohammedans," but these do not appreciably detract from the merit of the work. The author has not ventured on any prophecy regarding the attitude of the Ameer of Afghanistan with respect to the agreement.

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ENGLAND'S WORLD-POWER (England's Weltmacht). By W. Langenbeck. 117 pp., with 19 illustrations in the text. 8vo. Leipzig, 1907. B. T. Teubner. 1s. 3d.

A brief sketch of the world-power of Great Britain from the 17th century to the present day. in which the author rapidly reviews the commencement of British colonial policy at the time of Queen Elizabeth; the development of the Anglo-Saxon character during the 17th and 18th centuries; the raising of Great Britain to a world-power after her struggles against Spain, the Netherlands, and France; her commercial, maritime, and colonial development during the 19th century; her present-day political position; and the future of the British Empire.

The author concludes by discussing the possibilities of the collapse of the British nation owing to desire for money and luxury, the antipathy to manual labour, and the craving for sport, gambling, and betting.

THE REAL INDIA. By J. D. Rees, C.I.E., M.P. 345 pp. 8vo. London, 1908. Methuen. 10s. 6d.

An answer to the advocates of the National Congress movement in India. It has been well described as "a wholesome corrective to the propaganda of the school who are most active in instructing people at home upon Indian affairs."

The book deals chiefly with our administration of India, the causes of unrest, and proposals for reform, but the chapter on "Later History" deals with military policy on the North-West Frontier, with recent changes in military administration, and gives an account of the Indian Army, omitting, however, to mention the formation a year ago of the Northern and Southern Armies in place of the three "Commands."

The chapter on "Native States" deals with their military strength, the Imperial Service Troops, and very briefly reviews our relations with Arabia, Persia, Afghanistan, and Tibet.

The chapter on "Russia in the East" gives a short account of Russia's military position in Central Asia, and of the Anglo-Russian Agreement and its effect in securing the North-West Frontier.

The chapters on "Unrest and Reform," with remarks upon the attempts made to tamper with the loyalty of the Native Army, are interesting reading.

ENGLAND AND GERMANY. By Austin Harrison. 181 pp. 8vo. London, 1907. Macmillan. 2s. 6d.

The volume contains a series of letters, reprinted from *The Observer*, depicting the political relations between Great Britain and Germany. The writer endeavours to show with what suspicion we are regarded in Germany, and it is possible that he does not take an extravagant view of the situation. The letters are instructive and worthy of study.

WAR OR PEACE? OUR PROSPECTS IN A FUTURE WAR (Krieg oder Frieden? Unsere Aussichten in einem künftigen Kriege). By Colonel Gädke (Retired). 53 pp. 8vo. Berlin, 1907. Herm. Ehbock. 6d.

The well-known author of this little pamphlet has recently been forced to abandon his military title by the decision of a Court of Honour, and he now signs himself in the *Berliner Tageblatt*, to which paper he contributes articles on military subjects, as Gädke, late Colonel.

In the pamphlet under review he discusses briefly, and in a very comprehensive manner, the inferior political position in which Germany finds herself placed at the present day with respect to other Powers, and the errors of foreign policy which have been committed by German statesmen during the last 17 years. He attributes the situation entirely to the impetuosity of the Emperor and to the astute diplomacy of King Edward.

Great Britain is regarded as Germany's natural enemy, and although some space is devoted to reviewing the military position of Germany as compared with that of France and Russia, by far the greater part of this portion of the pamphlet deals with the naval

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situation as regards Great Britain and Germany. The question of war or peace between these two Powers is freely discussed, and the fear of Great Britain taking the initiative is the main argument which the author brings forward for the rapid strengthening of the German Navy, to which point the discussion throughout the pamphlet leads, and in which it culminates. With a Liberal Government in power in England, the author has no fear of aggression on the part of this country, but he fears the worst should the Conservative party once more assume the reins of direction of foreign affairs.

The pamphlet is well worth reading.

GERMAN ARMAMENT POLICY OF THE FUTURE (Deutsche Wehr-Politik der Zukunft). By a German abroad. 450 pp. 8vo. Zurich, 1908. Zurcher and Furrer. 3s.

In the introduction of this work the author, although hinting at the possibility of Great Britain attacking Germany, maintains that the last idea of the latter country is to go to war with Great Britain. Next to the German people he regards the British as the greatest nation in the world, far-seeing in their foreign policy, always knowing what they want and how to gain their ends. France, on the other hand, is regarded as the natural and hereditary foe, and the subject-matter of the book deals with the necessity for Germany of always maintaining an army on a peace footing which shall be vastly superior in numbers to that of France. Many of the earlier pages are devoted to the investigation of the existing establishments of all arms in the German Army as compared to that of France, and the author points out in what respects the army should be augmented. He is an advocate for fourth battalions being created on the French half-battalion system. According to him, no increase of expenditure appears to be necessary. The requisite increase of numbers may be obtained without spending a single mark by depriving officers of their "soldier maid-servants" and forming the new battalions with the 37,000 men thus obtained. He does not suggest how the question of officers' servants is to be dealt with, nor how the cadres for the extra battalions are to be created. The extra men for units of other branches of the service are to be got by reducing the periods of service, and so increasing the reserve. Other portions of the book are devoted to questions of leading and its improvement, hygiene, supply, and equipment, naval policy and the forming of alliances. Some 40 pages are devoted to discussing the financial position of the German Empire.

GERMAN EXPANSION OUTSIDE EUROPE (L'expansion allemande hors d'Europe). By E. Tonnelat. 290 pp. 8vo. Paris, 1908. Armand Colin. 3s.

An interesting work, dealing with German emigration to the United States, Brazil, Shantung, and South Africa, her colonies or possessions in those countries, and their political importance. The author reviews the whole history of the movement, from the time when Germany was a heterogeneous collection of states, large and small, up to the present day, when Germany is a world power, with boundless ambitions and a vigorous pan-Germanic policy.

The author is evidently of opinion that the Germans have not been an unqualified success as colonists; he pays a tribute to their energy, and asserts that Germany shrinks from no expense in furthering the development of her colonies; he adds, however, that she shrinks from no cruelty or barbarity in pursuing her object.

THE TRADE AND ADMINISTRATION OF THE CHINESE EMPIRE. By H. B. Morse. 393 pp., with 6 appendices, 2 maps, and several plates and photographs. 8vo. New York, Bombay, and Calcutta, 1908. Longmans, Green. 7s. 6d.

The author is an American and graduate of Harvard, who went to China 33 years ago, and holds a high position in the Inspectorate-General of Chinese Customs.

The scope of the book is greater than its title implies. The first portion contains a

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clear and succinct history of China from the earliest times. The following subjects are also dealt with:—Principles and method of government; the court, nobility, defensive forces, and public departments; revenue, taxation, currency, weights and measures; conditions under which foreigners reside in China; treaty ports, development of foreign trade, the opium question, Inspectorate-General of Customs, Post Office.

The appendices comprise a translation of an edict of 1906 re-constituting the Government and foreshadowing reforms in the provinces, also extracts from proceedings of law courts showing the nature of cases which come before foreign courts in China, reports concerning religious disturbances, and regulations for opium smoking.

The author expressly states that he is describing China as she is and was, and does not deal with her future in any way. Consequently he ignores the new Chinese Army, whilst describing the organization of the old "Banner" troops and giving the distribution of Manchu garrisons in China.

Most lucid are the explanations of the intricate official and social hierarchy, the bewildering currency systems, the *likin* arrangements, and the administration of the various foreign settlements. In each case the historical development is briefly sketched.

In dealing with the provinces the author describes the resources, natural products, and river systems of each, and gives statistics concerning trade and population.

THE FAR EASTERN QUESTION (La Question d'Extrême Orient). By Edouard Driault. 391 pp. 8vo. Paris, 1908. Félix Alcan. 5s. 10d.

In spite of a few inaccuracies, this work gives an excellent and unbiased summary of the Far Eastern Question, which the author defines as the question of the relation of the white to the yellow races.

Two chapters are devoted to the history of China and Japan in ancient times, and the remainder of the book deals with the period from the middle of the 16th century, when the Portuguese first found their way to the Far East, down to the present day. The part played by each European nation in opening up new channels for trade and missionary enterprise is clearly described, and an interesting account is given of the rise of French influence in Indo-China.

The Russo-Japanese War is considered from a political and not from a military point of view. The author says that it is not Russia alone that has received a check in this war. England has no other ambition than to act in agreement with Japan, before whom she effaces herself. The United States are afraid that they will not easily be able to establish their supremacy in the Pacific. France has suffered some disquietude regarding Indo-China, while Germany feels herself menaced in Kiao-chou, which can no longer be looked upon as the point of departure for a great German expansion in the Far East.

M. Driault is of opinion that China is about to follow the example of Japan in assimilating Western ideas, and that soon she will be able to defend herself against all attacks. When that time comes Japan will cease to be the leading Power in the Far East, and it is probable that Korea will again become a Chinese protectorate.

NAVAL.

THE ADMIRALTY OF THE ATLANTIC: AN INQUIRY INTO THE DEVELOPMENT OF GERMAN SEA POWER, PAST, PRESENT, AND PROSPECTIVE. By Percival A. Hislam. 209 pp., with maps and illustrations. 8vo. London, 1908. Longmans, Green. 6s. 6d.

In his preface the author of this book says that he has endeavoured to steer between the two prominent schools of thought, *i.e.*, between the naval reductionists and those who exaggerate the strength of the German fleet and belittle the strength of their own. He declares himself "actuated throughout by the conviction that the rise of German sea power is a factor in international politics which England can neither with safety ignore nor with dignity overrate, and firm in the belief that it would be better to sacrifice our dignity rather than our safety."

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He, then, in his first two chapters relates the history of the inception and development of the German fleet, and gives extracts from the speeches of such authorities as the Emperor himself, Admiral von der Goltz, and Admiral von Tirpitz, to show what is the object of the extraordinary efforts of the German nation and Government during the past 10 years to create as soon as possible a powerful fleet. Admiral von der Goltz pointed out how Great Britain was compelled to scatter her forces all over the world, while "the German fleet, though much smaller, can remain concentrated in European waters."

The next two chapters are devoted to a consideration of the German Navy of to-day, and to a comparison of that navy with the British. This comparison, with the exception of fast protected cruisers for fleet work and of torpedo craft, shows the superiority of the British fleet at present, but it also shows the rapid progress made by the Germans in recent years, and in the next chapter the author demonstrates how the Germans can build as fast as we can.

Mr. Hislam then considers the question from the point of view of the relative strengths of the two nations in the North Sea, and finds that the Nore Division of our Home Fleet is inferior to the German Active Battle Fleet, while he questions the policy of having a base at Berehaven.

The author then proceeds to a review of our naval bases, and lays great stress on the importance of the Nore, for "defensively it is situated at the most important point of commercial concentration in the United Kingdom, and . . . the status of the Nore from an offensive standpoint is no less important." He deplores the waste of money at Dover and has but cold encouragement for Rosyth. From this point the auther turns his attention to German naval bases, and shows how the geographical position of Germany acts to her detriment and to our advantage, and he considers that our forces should be so disposed as to enable us to close the passages (of the Straits of Dover or of the Shetlands) at an hour's notice. After some remarks on floating docks, of whose advantages Mr. Hislam is well persuaded, he passes to a chapter entitled "The Invasion of England." In this chapter he points out that an invasion of England from Germany is quite within the bounds of possibility unless there should be always a British fleet in the North Sea capable of demolishing the naval force which Germany maintains in those waters, and unless our fleet should be maintained in a state of perpetual readiness. From a consideration of British shipbuilding policy, the author demonstrates again our inferiority in torpedo craft, and he estimates that we ought to build at least 17 yearly to keep pace with Germany.

The book concludes with a brief survey of the navies of a few other powers, viz., France, United States, Japan, Russia, Italy, Austria-Hungary, Spain, and Brazil.

Taken as a whole, the book is decidedly worth reading, for it avoids extremist views in any direction and puts the facts before its readers in a clear and concise fashion. It will be of greater interest to the officers of the Navy than to those of the Army, but any book which deals with questions affecting the defence of these islands and with our power of offence should be studied by all who are interested in the military profession.

STRATEGICAL AND TACTICAL.

THE EMPLOYMENT OF DETACHMENTS AND THE SERVICE OF RECONNAISSANCE IN THE CAMPAIGN IN THE EAST OF FRANCE (1870–71) (La couverture au cours de la campagne de l'Est (1870–71)). By Capt. S. Bourguet, French Artillery. 60 pp., with 13 sketches and diagrams. 8vo. Paris, 1906. Berger-Levrault. 1s. 8d.

This little brochure deals with one of the later campaigns in the Franco-German War (between Bourbaki and Garibaldi on the French side, operating against Werder and Manteuffel), a campaign which hardly receives sufficient attention in this country, though it presents features of particular interest for Englishmen.

The author has brought out certain points very clearly, *e.g.*, the necessity of adequate reconnaissance, and the impossibility of carrying this out with any but the very best cavalry; the unreliability of imperfectly trained artillery; the inability of partially-trained troops to contend with a highly-disciplined enemy; the uselessness of holding attacks

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unless they are executed with vigour and resolution; the importance of mutual co-operation; the value of initiative, energy, and determination, as shown by the way in which the German general, Kettler, handled his weak detachment in the operations near Dijon against the greatly superior forces under Garibaldi.

This campaign resulted in the neutralization in Swiss territory of about 80,000 French troops, a disaster almost as great as that of Sedan. This calamity occurred, moreover, at a most unfortunate time, as its effect was to discourage the French and to blight their hopes, now beginning to rise in consequence of the wave of patriotism which had spread over the country, and as a result of the energetic and partially-successful operations of Chanzy and Faidherbe.

ADVANCED GUARDS (Essai sur les Avant-Gardes). By Capt. N. Coucke, of the French General Staff. 105 pp., with diagrams. 8vo. Paris, 1907. Berger-Levrault. 1s. 8d.

This is a useful little volume, showing very clearly the French conception of the *rôle* of an advanced guard. It examines the duties of the commander of an advanced guard in various situations, the strength and composition of his force, the parts played by the different arms, and their co-operation in action. The author treats the question of the protection of an army on the march, both at a distance from and in close proximity to the enemy. He also discusses the use of a general advanced guard to an army, as opposed to the system of employing advanced guards for each column.

The book abounds in comparisons between French and German methods, and as such is of considerable interest; it deals with the regulations of various countries on the subject, and gives details regarding the system of forming advanced guards. It is written in easy French, is of a handy size, and is well worth reading.

SIEGE WARFARE AND THE MANŒUVRES ROUND THE FORTRESS OF LANGRES IN 1906 (Étude sur la guerre de siège, et la manœuvre de forteresse de Langres en 1906). By Lieut.-Colonel Klein. 86 pp., one map. 8vo. Paris, 1907. Berger-Levrault. 2s. 6d.

In 1906 the French introduced a new departure from their ordinary manœuvres by practising an attack on the large fortified camp of Langres, an innovation the advisability of which was probably suggested by the Siege of Port Arthur. The experiment proved a decided success, and the various mistakes showed the importance of gaining experience in this difficult branch of the art of war.

Lieut.-Colonel Klein has given us an interesting description of the operations, with useful notes on the duties of the different arms of the Service, both in attack and defence. He draws attention to the trying nature of the work involved, and points out the necessity of employing highly trained troops in the siege of fortresses, showing how, in spite of all improvements in modern firearms, the human element is still omnipotent.

TRAINING AND EDUCATION.

STAFF RIDES AND REGIMENTAL TOURS. By Colonel R. C. B. Haking. 495 pp. 8vo. London, 1908. Rees. 8s. 6d.

Colonel Haking has had a large and varied experience of Staff Rides, and we have here the result of that experience, which will doubtless be of great use to the many officers who have felt the want of a book which would serve as a guide to them both in the preparation of a scheme and in the subsequent conduct of a Staff Ride. After perusing this volume it will be conceded that the author has succeeded in producing a book which will serve the purpose indicated above. This book is intended to deal with Staff Rides held by Divisional and Brigade Commanders, and with Regimental Tours, and is not concerned, the author says, with very large Staff Rides, and he draws a distinct line between Staff Rides for the instruction of Staff officers and Regimental Tours for Regimental

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officers. Colonel Haking goes deeply into the question of the preparation of schemes and gives many instances from military history which may be used. These instances may be useful to Directing Staffs, and may give them an indication as to campaigns and situations which they should study when working out a scheme.

From the preparation of schemes, Colonel Haking passes to a chapter on the method of directing a Staff Ride, wherein is contained a number of hints which will doubtless be of great value to officers who have not had much experience in the matter.

Single Staff Rides are then dealt with, and Staff Rides for practising operations against semi-civilized or savage races, and examples of problems suitable for Staff Rides, with instructions for reconnoitring officers.

The next chapter deals with the method of preparing narratives, and in this connection Colonel Haking remarks, "It is most important that officers should not be allowed to do things on a Staff Ride which they would not even suggest in real war . . . during a Staff Ride it is best to assume the most difficult situation in each case"; and in the next chapter on criticisms he says, "The object of criticizing the work is . . . simply to inculcate sound principles of strategy, tactics, and administration."

We then have chapters on the work done by officers during a Staff Ride (Appreciations, Orders and Instructions, Reports, Sketches, etc.), on Regimental Tours, on the conduct of Tactical Exercises on the ground and on one-day exercises, and finally a short chapter on War Courses.

The value of this book will be great to all who are conducting Staff Rides, and also to those taking part in them, and Chapters XVII., XVIII., XIX., and XX. will be of special interest to commanding officers who are responsible for the training and education of their officers. It will supply a want, and it inculcates the principles of the training manuals, which, as the author says, should be the "sheet anchor" of officers.

TACTICAL EXERCISES AND WAR GAMES (Thèmes tactiques et Jeu de la Guerre). Translated by Capt. Corteys, of the 140th Infantry Regiment. 212 pp., with 3 maps. 8vo. Paris. Lavauzelle. 4s.

This useful volume, which is translated from the German, is divided into two parts. The first part deals with the framing and solving of tactical exercises, and is valuable on account of the clear insight it affords into German tactical and strategical ideas, and into their school of thought. General Litzmann, the author, was formerly Commandant of the Berlin Staff College, so that his views and teachings are of considerable value. We see throughout the value attached by the Germans to the spirit of the offensive, the initiative, mutual co-operation, rapid decisions, and the determination to conquer at all costs. It is brought out very clearly that the Germans prefer rapid decisions and energetic action, even if not absolutely the best possible means of dealing with a situation, to hesitation, indecision, and inaction. The problems propounded are of value as a set of well-thought-out exercises, whilst the solutions are carefully argued and contain useful lessons.

The second part deals with war games, and gives various rules for their conduct. It also describes a series of exercises drawn up for young officers, and shows the methods to be adopted in the case of novices at this work, as well as those for more senior officers. A feature of the German system is the way in which these games may be directed by officers junior to numbers of the participants; though General Litzmann urges the points in favour of this system, its success would appear to demand very great tact on the part of the director.

LETTERS ON APPLIED TACTICS. By Colonel Griepenkerl. Translated by R. Maxwell. Brought up to date by K. von Donat. 498 pp. 8vo. London, 1907. Rees. 8s. 6d.

This is the fifth edition of the excellent translation of the well-known studies of tactical exercises, worked out by Colonel Griepenkerl.

The twenty-four problems selected deal with small detached forces of all arms, and are worked out with great detail and thoroughness.

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The book is accompanied by five very good maps of the country round Metz, which is the district in which the imaginary operations take place.

For the benefit of British officers studying for the Staff College, or for promotion examinations, the translator deals with British Army units corresponding as nearly as possible to those of the German Army in the original; and calculations of time and space have been amended in accordance with Combined Training, 1905.

TRAINING AND TACTICS. By Capt. H. M. Johnstone, R.E. (Retired), with a preface by Lieut.-General Sir E. P. Leach, V.C. 158 pp. 12mo. London, 1908. Oliver & Boyd. 1s. 6d.

This is a useful little book for the purpose for which it is intended, *i.e.*, to be useful to members of the Officers' Training Corps. A few points have been noticed in which the information given is not quite correct, notably in Chapter X. and the Appendix. Chapter IV. does not seem to be quite in accord with Chapter VII., *Cavalry Training, 1907*. In the main, however, the book will serve to explain and amplify some parts of Combined Training and Infantry Training.

INDIVIDUAL AND COMBINED MILITARY SKETCHING. By Capt. E. T. Cole, 6th United States Infantry, and Capt. R. Stuart, Corps of Engineers, 2nd edition, revised. 8vo. New York, 1907. U.S. Cavalry Association. 5s.

The authors of this book deal with the subject in a plain and practical manner. Due weight is accorded to the governing factors of rapidity and military judgment in sketching. The practical hints for acquiring the art of showing form of ground are excellent.

Part II. deals with combined sketching, the organization of parties to carry out the work within time limits, and the tracing and blue printing of the map so produced. A special celluloid paper is strongly recommended for field use. This book is specially suited to cavalry sketching instruction.

FORTIFICATION AND MILITARY ENGINEERING.

TYPES OF FIELD WORKS EMPLOYED IN THE RUSSO JAPANESE WAR.—By S. A. Tsabel. 119 pp. 8vo. St. Petersburg, 1907. V. Berezovski. 5s. 6d.

The title should read "Types of Russian Field Works, etc.," as Japanese works are not dealt with.

The author commences by tracing the change in Russian methods, which took place during the war, from hasty fortification on its early stages to the more deliberate and solid work which the lengthy pauses in the active operations permitted during its later stages. Shallow trenches, to give cover kneeling, proved to be inadequate. The wide Japanese turning movements forced the Russians to occupy extended fronts which could be only thinly held, and consequently had to be strongly fortified.

The disadvantages of the narrow and deep shelter-trench without a parapet are dilated upon. It is not easy to find a good site for it; in low ground it is unsuitable, because the smallest irregularity of surface in front obstructs its field of fire. When sited upon slopes fronting the enemy it is conspicuous when the sun shines, for the cast shadow of the trench makes it noticeable from afar, and it is difficult to dispose of the excavated earth so that it may not be seen. The best site for it is the crest-line of a ridge, where the inside is not visible, and the excavated earth can be easily got rid of. It is also too narrow to admit of men passing along it behind the riflemen holding it. The author declares in favour of a trench to give cover standing, and with a command of from 14 to 28 inches, as the most generally useful type.

Blindages were of two types—a splinter proof, consisting of poles covered with *kowliang*, and with from 6 to 8 inches of earth, and a more solid type, intended to keep out the Japanese high-explosive shell, consisting of a layer of timbers with 3½ feet of earth over them.

Nearly 40 pages are devoted to discussing the various types of field redoubts. Of

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two general types, that with a shallow ditch and that with a deep ditch, the former is preferred when combined with an efficient obstacle. The second type is advisable only in second line, where concealment is of less importance, and when the ground is sufficiently firm to permit of steep slopes.

Manchurian villages are very defensible, and were often used as tactical pivots. They have thick and high mud walls, and are not inflammable. The method of fortification varied with the size of the village and the tactical purpose. The whole perimeter of small villages was usually prepared; in the case of large villages, which were to be obstinately held, only the front edge was fortified, and a keep was prepared inside.

The necessity of always entrenching guns, whether in open or concealed positions, is insisted upon.

The use of obstacles on the Russian side degenerated into abuse as the war went on, and Russian depression and passiveness increased. The smallest gap in the hedge of obstacles was at once closed by the troops themselves. In the Shih-ping-kai position the 2nd Army alone used 340 tons of barbed wire. The height of wire entanglements was repeatedly changed in the hope of keeping out the Japanese. It is significant to read that the Commander-in-Chief, when inspecting the Shih-ping-kai position, found fault with the wire entanglements as being too low, and issued a general order on the subject. These were the obstacles most generally used. Military pits were found to be of little use unless combined with wire entanglement, and often afforded cover to the enemy. Abatis were little in vogue, being very liable to destruction by artillery fire, and the necessity of carefully screening all obstacle from view and fire was proved to be a very real one. In the prolonged battles, which caused great nervous exhaustion, fougasses produced a great moral effect. It was generally agreed that all obstacles should be placed from 50 to 60 paces in front of the firing line which defends them.

The pamphlet is written almost entirely from an engineering point of view, and the tactical and psychological side of field fortification is hardly touched upon. The writer shows a complete failure to realize the true causes of the Russian defeats, in that he attributes them to numerical superiority on the side of the Japanese, which enabled them to execute wide turning movements. In concluding, he expresses regret that the conclusion of peace prevented the administration of a final "repulse" to the Japanese, and notes with pride that military engineering has never flourished in the Russian Army as it did in the recent war.

The pamphlet is accompanied by an atlas of 34 plates of field works.

REINFORCED CONCRETE IN THE CONSTRUCTION OF FORTIFICATIONS (Le béton armé dans la construction des ouvrages de fortification). By Lieut.-Colonel A. Algrain. 20 pp., with numerous diagrams. 8vo. Brussels, 1907. Goemaere. 1s. 8d.

The author deals with the properties of this new and important preparation, and describes the various uses to which it is capable of being put. The pamphlet is interesting, and may be useful to Engineer Officers.

AERIAL NAVIGATION.

DIRIGIBLE BALLOONS (Les ballons dirigeables. Théorie. Applications). By MM. E. Girard and A. de Rouville. 310 pp., 143 diagrams. 8vo. Paris, 1907. Berger-Levrault. 4s.

This volume is made up of a collection of articles which appeared in the *Revue de Génie militaire français* during 1906 and 1907, enjoying considerable popularity at that time.

The work has undoubted merit, though there are various defects, of which it may be advisable to mention the following:—There is a certain amount of unnecessarily precise and detailed calculations with regard to points of comparatively minor importance; the discussion on the motors now used for the propulsion of airships is somewhat too short; the authors hardly appear to have treated the German airships with impartiality, and

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seem to have allowed their sense of strict and scrupulous fairness to be overcome by their feelings of patriotism and preference for everything that is French.

In spite of these drawbacks, the book contains much useful research and valuable information, and is well worth reading by those interested in aerial navigation.

THE CONQUEST OF THE AIR (Die Eroberung der Luft). By Graf Zeppelin. 31 pp. 8vo. Stuttgart and Leipzig, 1908. Deutsche Verlags Anstalt. 9d.

The pamphlet contains the subject-matter of a lecture delivered by the famous aeronaut in Berlin on the 25th January last.

The possibilities of the capabilities of dirigible balloons of the future are entered into, and the lecturer very naturally lays considerable stress on the advantages of the rigid system of construction which he has adopted in his own airships.

ORGANIZATION AND ADMINISTRATION.

MARCHES AND SOLDIERING IN TIME OF PEACE (Routes à l'intérieur. Droits et devoirs des autorités militaires vis-à-vis des autorités civiles). By Capt. G.R., French Artillery. 130 pp. 8vo. Paris, 1908. Chapelot. 1s. 8d.

A useful little book, dealing with the movements of troops in time of peace in France. It shows the French system of billeting and of obtaining forage and supplies, and gives numerous examples of the way in which the civil authorities should co-operate with the military officers, and *vice versâ*.

CONCERNING THE QUESTION OF DEFENCE, ORGANIZATION, EQUIPMENT, AND TRAINING OF MOUNTAIN TROOPS IN SWITZERLAND (Zur Wehrfrage. Organisation, Ausrüstung und Ausbildung von Gebirgstruppen in der Schweiz). By Major Froelich. 88 pp. 8vo. Aurau, 1907. Sauerländer. 1s. 6d.

This pamphlet contains the text of an essay which won the first prize in a competition set by the Officers' Association of Switzerland. The judges, though commending the work highly on the whole, made the following unfavourable criticisms:—The author has not sufficiently regarded the question from the point of view of the whole army, but has bestowed such ample resources and so large an amount of care on the mountain troops that other parts of the army would undoubtedly suffer. His scheme, furthermore, involves too great a break with existing institutions. He has evolved a completely new and ideal organization, instead of attempting to improve and build upon that which already exists.

The Swiss could undoubtedly draw from their population an abundant and very suitable material for a special corps of mountain troops, and it would appear eminently desirable, from the point of view of the defence of the Republic, that an organization of this nature should exist.

This work contains admirable suggestions for the composition and formation of such a corps, and the question of organization, equipment, and training are dealt with in a thoroughly practical manner.

BOOKS OF REFERENCE.

VON LÖBELL'S ANNUAL REPORT ON ARMIES AND MILITARY MATTERS. XXXIVTH EDITION, 1907 (V. Löbell's Jahresberichte über das Heer- und Kriegswesen. XXXIV. Jahrgang, 1907). Edited by Lieut.-General von Pelet-Narbonne. 495 pp., with 8 photograph plates. 8vo. Berlin, 1908. Mittler. 14s.

For a review of the 1906 edition see No. 2, page 20.

Part I. is a useful guide to the military systems and organizations of foreign armies. It

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cannot, however, be relied on as accurate as regards numbers and establishments, and it omits mention of many important changes.

Part II. deals with the development of tactics, fortification, means of communication, and *matériel* in the various military states.

In a general survey of the year's progress in the countries dealt with, the authors note the prevalence of more moderate views on many points; notably as regards the dismounted action of cavalry, wide extensions of infantry, and the use of entrenchment in the attack. Infantry in most countries advance by longer rushes than formerly, and in parties of not less than a section; artillery support must go hand in hand with the infantry advance, but batteries will not always be able to accompany it, and permanent superiority of fire is seldom to be expected. Cavalry must co-operate on the battlefield and in the pursuit; the moral exhaustion of infantry may offer the cavalry opportunities for shock action against them.

Machine-gun companies are being experimented with in many countries, and will probably be definitely allotted to infantry regiments.

Cyclists have been found useful auxiliaries both for cavalry and infantry. The company of 150 strong has proved the most serviceable unit, but in France the battalion organization with the cavalry division will probably be adopted.*

On the defensive, continuous lines are disappearing, and artillery and infantry positions are separately considered; but it is thought that the execution of a decisive counter-stroke, with this form of tactics, requires higher ability than formerly on the part of the commander of the force.

The silence of foreign manuals on the subject of "battles of encounter" is again commented on, but some warnings are also quoted against the German predilection for this form of combat, which is alleged to be inapplicable to large armies, and to encourage adventurous tactics for advanced guards.

Dealing with the several countries, Part II. reveals the profound difference between the French and German schools of thought, and while every development of tactics is held to justify the teaching of the German manuals, there is an inclination to exhibit the French methods as academic and unpractical.

In the attack the German tendency is to hold the enemy fast in front, while a decision is sought by fresh columns continually overlapping the flanks. The attacking units must use such cover as exists in the front allotted to them. The characteristics of the infantry attack are delayed opening of fire and dense firing lines when once fire is opened, whilst the guns are directed chiefly upon the enemy's infantry. The impulse for the assault is often given by the firing line.

In France the tendency is to seek a decision by the penetration of the enemy's front; open ground is considered impassable, and the attack only advances where cover exists. Distinct bodies of troops are used for the fire-fight and the assault, the latter being delivered on a narrow front by the direction of the commander of the force.

Cavalry.—In Germany the cavalry are overcoming their dislike to the carbine, but are practically limited to the defensive in dismounted fighting. The English regulations on the subject are thought preferable by the authors. In France the lower standard of efficiency anticipated from the two years' system has caused the elimination of the light divisions, and is expected to lead to the introduction of cyclists as a support for the cavalry, and is held up as a warning against short service in this arm. There is alleged to be a tendency to wide outflanking manœuvres, which may prove dangerous before a vigilant enemy.

Artillery.—The chief points to note are the re-armament of the German Field Artillery with the 96 n/A. equipment and the projected increase of artillery in France. The new German and Austrian regulations are reviewed at length.

Colonel Balck's studies of the Siege of Port Arthur initiate a new era in fortress warfare. Infantry must interest themselves more in this question, and artillery must co-operate with the infantry, as in field operations. Specially trained pioneer troops will be required for the struggle for the counterscarp.

Lighter bridging trains and improvised bridges are the subject of much attention in Austria, Germany, and France.

* *Note by General Staff.*—No such decision has yet been arrived at so far as is known.

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Part II. also contains articles on telegraphy in South-West Africa, wireless telegraphy, small arms, and artillery *matériel.*

Part III. gives an account of the military expeditions which have taken place in the German Protectorates during the year, and an obituary for the armies of all nations is given in the concluding pages.

THE ENCYCLOPÆDIA OF ISLAM. No. 1. Prepared by a number of leading Orientalists under the supervision of Dr. M. Th. Houtsma, a professor of the University of Utrecht, and Dr. M. Seligsohn. 64 pp. 8vo. London, 1908. Luzac & Co. 3s. 6d.

This is the first instalment of a dictionary of the geography, ethnography, and biography of the Muhammadan peoples. The work promises to prove of value as a book of reference.

TRAVEL AND TOPOGRAPHICAL.

RICHARDS' COMPREHENSIVE GEOGRAPHY OF THE CHINESE EMPIRE. Translated into English, revised and enlarged, by M. Kennelly, S.J. 639 pp., 4 maps in pockets, and numerous maps in text. 8vo. Shanghai, 1908. T'usewei Press. 17s. 2d.

The original work was published in French in the year 1905, and has been brought thoroughly up to date by the translator.

The volume is divided into two books. Book I. deals with China Proper or the 18 provinces, and Book II. with the Outer Dependencies.

Book I. opens with a general geographical survey of the 18 provinces; the area and population of each is given, and a brief description added of the geology, mountain systems, climate, waterways, and vegetation.

In considering the geography of the country in detail, the author divides it into three regions, and devotes a section to each.

Section I. describes the northern portion, comprising the basins of the Huang-ho and Pei-ho.

Section II. deals with the central section, viz., the basins of the Yang-tzu and Huai Ho.

Section III. treats of the southern section, embracing the basin of the Hsi-chiang and the coast provinces of Fu-chien and Che-chiang. A separate section (IV.) is devoted to a description of the coast line.

Section V. deals with the administration of the government, revenue and expenditure, the Imperial Maritime Customs, the Army and Navy, inhabitants and communications; this section also contains a brief history of the Empire.

In describing the military forces the author gives details of the modern army (Lu Chün as well as of the old troops), which tally in the main with those gathered from other trustworthy sources of information on this subject. Some details are given regarding arsenals and forts. In dealing with the physique and character of the inhabitants the author writes in a somewhat depreciatory vein as far as the latter is concerned. In the chapter on communications a useful list of postal roads is given, also a list of railway lines completed in 1907, with designation, particulars of management, and mileage (English). A separate list is given of lines under construction.

The historical chapter contains a tabular list of dynasties, as well as a concise account of the relations of China with foreign powers.

Book II., which is much more condensed than Book I., gives a short description of Manchuria, Mongolia, Chinese Turkestan, and Tibet.

The volume concludes with lists of the prefectures and sub-prefectures of the 18 provinces, Manchuria and Chinese Turkestan, an alphabetical list of the cities and towns of China arranged according to their radicals, and a similar list arranged according to their romanized names. There are five appendices and an excellent index.

A great feature of the work is that at the end of each chapter there is given a very complete list of standard authors (French, English, and German) who have dealt with the subjects of the chapter. The Chinese character is given in the case of all names and

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technical terms. The transliteration of Chinese words is a great stumbling block to all European writers. The author has adopted the Nanking dialect (Southern Kuan-hua) in preference to Pekingese (Northern Kuan-hua), and has evolved a system of transliteration which he considers embodies the best elements of Morrison, Williams, Wade, Giles, and of the recent Postal List. His system has much to recommend it, and as the Chinese character is always given, there is no difficulty identifying the places named.

The names on the four maps in pockets are written in Chinese characters, and the prefectural and district towns indicated by special signs. The names of the treaty ports are underlined, and the romanized names of the more important places are given. The maps show by coloured washes the average altitude of the land and the depths of the adjacent seas. There are also 42 maps, diagrams, and illustrations in the text, illustrating the geological features of the country, the districts in the vicinity of the more important cities, railways, river systems, etc.

The work contains a very large amount of reliable information, is well up to date, and can be most thoroughly recommended to all persons desirous of obtaining a knowledge of the Chinese Empire.

MISCELLANEOUS.

INTERNATIONAL LAW IN THE RUSSO-JAPANESE WAR ON LAND FROM THE OFFICIAL DOCUMENTS OF THE JAPANESE GREAT GENERAL STAFF (La guerre Russo-Japonaise au point de vue continental et le droit international d'après les documents officiels du grand état-major japonais (section historique de la guerre 1904–5)). By Nagao Ariga. 8vo. 587 pp. Paris, 1908. A. Pedone. 12s.

This is the Japanese official account of the leading cases of international law and the custom of war which were dealt with during the operations on land. As a collection of precedents the work is of the highest value, and will, without doubt, become a classic; for the British Army, which, except to a very limited extent in the South African War, has had no occasion to devote much time to the questions considered in it, it is of special importance.

The author Professor Ariga, has been Professor of International Law at the Japanese Staff College since 1891, and at the Japanese Naval Staff College since 1896; he was adviser to the Japanese Headquarter Staff in the China Campaign of 1894–5 (on the international legal aspects of which he wrote a volume in 1896), and during the late war was Legal Councillor on the Headquarter Staff of Marshal Oyama, and was specially sent down to advise General Nogi during the siege of and negotiation for the surrender of Port Arthur. He has been technical delegate at both The Hague Peace Conferences.

Although every Japanese General Staff Officer receives very thorough instruction in international law while at the Staff College, the Japanese authorities considered that in many cases an amateur knowledge of the subject was insufficient, so in addition to appointing their greatest living specialist to the Headquarter Staff in the field, and Prof. Akiyama (who represented Japan at the Geneva Conference) to advise the Minister of War in Tokio, they attached two international jurists to the General Staff of each army in the field, and one jurist to the General Staff of each army of occupation. The Japanese Great General Staff realized from the study of past campaigns that war cannot be carried on without affecting neutral powers, and that many diplomatic difficulties and claims for compensation may be avoided by authoritative instructions to the troops and correct treatment of cases in the first instance; that as no advantage obtainable should be sacrificed in war, it is of immense importance that the utmost value should be extracted from existing international agreements and precedents; that war is not a game but a business, a sink-or-swim struggle, not to be carried on in accordance with sporting instincts, but with a definite code, which must be interpreted not in the interests of humanity, but of one's own army.

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In bringing the declaration of war to the knowledge of his people the Emperor of Japan specially drew the attention of officers as well as civil functionaries to the correct application of international law:—"We declare war against Russia by these presents, and we command our army and our navy to carry on war against her according to their duty and with all their might; we also command all our competent authorities to use all their efforts in the accomplishment of their functions, in order to achieve the object which our country is pursuing by all the means admitted by international law and custom."

The Legal Councillors, who were all chosen from the members of the International Law Association at Tokio, were in some cases officers of the reserve; these served as officers; the others served as Volunteers, but were given the relative rank of officers and wore swords; a double triangle on the left sleeve and the absence of spurs were the only signs which served to differentiate them from other officers. "Every time that a question of international law came before the staff these councillors were consulted; they were also charged with the drawing up of instructions and regulations on the subjects relative to the laws and customs of war."

The book is divided into 20 chapters dealing with:—(1) The outbreak of war and its immediate consequences; (2) The theatre of war; (3) Combatants and non-combatants; (4) Prisoners of war; (5) Sick and wounded; (6) Dead; (7) The organization and *personnel* of the medical service; (8) The Japanese Red Cross Society; (9) Means of injuring the enemy; (10) The siege and bombardment of Port Arthur; (11) The capitulation of Port Arthur; (12) The protection of life and property in Dalni and Port Arthur: (13) Military jurisdiction and martial law; (14) Limitation of the right of possession of arms; (15) Administration of occupied territory; (16) The duties of inhabitants of occupied territory; (17) The protection of missionaries, historic buildings, and large towns; (18) The occupation of Saghalien; (19) Neutrality on land; (20) The armistice and peace.

The book naturally contains very numerous matters of interest, to refer to all of which is not possible in a review of moderate length.

As early as the 4th January, 1904 (that is more than a month before war began), in a special edition of the *Official Gazette*, the Japanese Government forbade the press "to publish any news concerning the movements of troops and war vessels without special authorization of the Ministry of War and the Ministry of the Navy." It is remarkable that this notice was issued while peaceful negotiations with Russia were still pending; it is a precedent that no doubt every Power will follow during times of strained relations, without fear of its being regarded as an unfriendly act; it is merely a reasonable measure of precaution.

A proclamation was issued to the governors of provinces with regard to the treatment of Russian subjects resident in the Empire; these were given, "as an act of grace," complete freedom to go or to remain, and were assured of the protection of their lives, honour, and property, provided they went about their usual business, with the important restriction, however, "in the execution of necessary administrative acts, or the surveillance ordered and other measures taken by the naval and military authorities for military purposes, the Imperial Government admit no restriction, and may limit in part the guarantee given as regards personal liberty, life, and property, and furthermore may forbid or limit any change of domicile or travelling, as they judge fit." As all Russian subjects were registered with the police in time of peace, no difficulty was found in controlling and protecting them.

Steamers were sent by the Japanese Government to the Siberian ports to withdraw Japanese subjects. The Governor of Vladivostok gave notice on the 3rd February that he was authorized to declare a state of siege, and when declared the Japanese residents would be obliged to leave within three days.

After occupying Vladimirovka, in the Island of Saghalien, the Japanese shot 20 inhabitants who had taken part in the defence, because they did not conform to one of the four conditions required of volunteers in Article I. of The Hague Rules, attached to the "Convention concerning the laws and customs of war"; they had no "distinctive mark visible at a distance" to show that they were combatants and to prevent their being able, when captured, to pretend they were peaceful inhabitants.

Professor Ariga is, however, of opinion that Article 1 should not be too rigorously applied; it may occur that non-combatants and civilians on a line of communication may be required to assist in repelling a raid (as happened at Anju, where post and telegraph

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officials, sutlers, and merchants took part), and it is surely not intended that they should be shot if they should be captured without a distinctive mark on their dress.

In dealing with the question of prisoners, Professor Ariga regrets that there is no conventional sign of surrender for individuals, and states there were many misunderstandings from lack of this. One Russian came up to a Japanese sentry and kissed him on the cheek, and was promptly attacked with a bayonet; "hands up," therefore, would not seem to be in general use. Possibly no army is much concerned with teaching its men to surrender.

After a battle, when a large number of prisoners were taken, a committee was appointed to deal with them; the president took command of the troops detailed as guard, and the members dealt with special questions. One staff officer attended to the documents found on the prisoners, another to their quartering and transport; a medical officer and a supply officer saw to their health and to their feeding.

As usual, both belligerents made a number of charges and counter-charges of cruelty, of firing on hospitals and ambulances, of abuse of the white flag and of the red cross flag, and of use of soft-nosed bullets. Professor Ariga points out the necessity of taking proper evidence and disposing of such cases at once.

The very careful regulations for clearing up a battlefield, burying the dead, and securing their property in accordance with the Hague Rules are given at length.

It is of some interest to find a learned professor, while admitting that it is a violation of the laws of war to take the clothing of a prisoner, defending the Japanese who took boots from the Russians, "because their object was not to enrich themselves, but solely to be in a position to serve their country better." Those whose wardrobes suffered in South Africa will appreciate the good motive.

Many of the cases which gave the Japanese trouble have now been set at rest by the Geneva Convention of 1906, but the new Convention has left a certain number of matters in doubt. For instance, from Articles 7 and 9 it might be argued that the medical *personnel* is protected "under all circumstances," even when it behaves in a manner harmful to the enemy; but the Japanese very rightly hold that persons displaying a red cross flag or carrying stretchers are not entitled to come to a place close to a hostile line, whence they could glean useful information. Professor Ariga holds they may be captured, or, if it is not possible to approach them, that fire may be opened in their direction to warn them to retire; if they persist in advancing they may be fired on. Similarly, if a red cross train or convoy is observed it may be called upon to halt by firing a shot, as it were, across its bows; if it refuses to stop, it may be fired on.

It is held that the medical corps has the right to make prisoners if attacked, for the best way of defending oneself against an adversary is to disarm him; but the author does not approve of the conduct of the staff of a hospital which assisted a battalion of heavy artillery to defend a village against some Russians who had come up from the rear, having lost their way in the retreat during the first stage of the Battle of Mukden.

It is regrettable to find that the word "dum-dum" is used by the Japanese to describe a soft-nosed bullet.

Professor Ariga decides that the ruse employed by General Lenevich by which he effected an undisturbed retirement at the Battle of Mukden, under cover of a truce to bury the dead, was legitimate. "It was our generals," he says, "who let themselves be deceived."

It was laid down in Japanese regulations that "the sole fact that the enemy hoists a white flag does not necessarily indicate an accomplished surrender, and fire should not therefore cease on this account; it is by sending *parlementaires* that arrangements are made."

The negotiations for the surrender of Port Arthur and the documents drawn up to carry it out are very fully dealt with, as are also the measures taken for handing over the fortress. They will no doubt form the precedents for all future proceedings of the kind. Four committees dealt with the handing over:—(1). The first, divided into four sub-committees, dealt with (*a*) the forts, batteries, arms, munitions of war; (*b*) ships; (*c*) provisions; (*d*) dangerous objects. (2). The second with prisoners of war. (3). The third with hospitals and sick and wounded. (4). The fourth with the ordinary inhabitants, the transfer of the civil administration, finances of the town, and other questions of detail.

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During the siege the arrangement of suspensions of arms for collection of wounded and dead was left to the divisional generals.

The Japanese authorities declared that they took no responsibility for private property left behind unguarded in Port Arthur, or elsewhere in the theatre of war, as they had insufficient means at their command to prevent theft and fire :—"The Japanese Army can assume no responsibility for the private acts of thieves, burglars, incendiaries, etc."

In their empire, all necessary powers being provided by statute law, martial law is only proclaimed by the Japanese in a foreign country. No uniform code was promulgated ; Marshal Oyama laid down that "the circumstances in which martial law is applied are so infinitely various . . . that it is best not to limit the liberty of action of the military authorities by uniform rules." The Commander of the Fourth Army did formulate and issue very clear and precise rules, but was ordered to withdraw them by Army Headquarters. The legal councillors were, however, unanimously of opinion that rules are necessary :—"It is contrary to all principles of repression not to declare beforehand what acts are or are not punishable . . . the object of martial law is not to punish, but to menace with punishment, to prevent acts harmful to the army ; to attain this end publication is most necessary." The action of the Japanese Headquarter Staff is very significant, as it is no doubt founded on Continental practice. Professor Ariga gives a very useful list of headings to be included in martial law regulations.

Both Japanese and Russian Armies threatened, if they did not enforce, "collective punishment" of inhabitants for damage to railways, telegraph lines, etc. Article 50 of the Hague Rules reads :—"No general penalty, pecuniary or otherwise, can be inflicted on the population on account of acts of individuals for which it cannot be regarded as collectively responsible." The Japanese kept inside the law by making villages, by notice, collectively responsible that no damage was done within a certain radius of them.

Article 31 of the Hague Rules lays down :—"A spy who, after rejoining the army to which he belongs, is subsequently captured by the enemy is treated as a prisoner of war, and incurs no responsibility for his previous acts of espionage." The Japanese held that this rule did not apply to inhabitants who had assisted the Russians as spies, and were caught at their homes when the Japanese Army advanced.

The Japanese authorities confiscated the property of inhabitants who had notoriously assisted the enemy as contractors, etc., and absconded, or were absent and did not surrender when the Japanese gained possession of their property. This would appear to be contrary to Article 46 of the Hague Rules, which says distinctly "Private property cannot be confiscated" ; but apparently, by Japanese law, confiscation of property is still a penalty for treason, and Professor Ariga quotes as a precedent that "in 1870 the German Army confiscated, or menaced with confiscation, the property of men of military age in Alsace and Lorraine, who, being absent from their homes, might be supposed to have participated in the struggle against the German Army."

It will be observed from the *précis* given above that the practice of the Japanese Army, which is founded on a careful study of the best European precedents, differs in some cases from that observed by the British Army in South Africa. It cannot, however, be doubted that the Japanese Army gained very considerable advantages from the interpretations given by its experts, and similar interpretations must be expected in European warfare.

WHAT ONE OUGHT TO KNOW ABOUT THE GERMAN ARMY (Ce qu'il faut savoir de l'Armée Allemande). 112 pp., with 6 plates, 1 map, and diagrams in text. 8vo. Paris and Limoges, 1907. Lavauzelle. 1s. 1d.

This little book, published probably in answer to the German pamphlet entitled "Was man von der französischen Armee wissen muss" (What one ought to know about the French Army), which was brought out in the early part of 1906, contains a concise and useful description of the organization, armament, equipment, and tactics of the German Army. As regards organization, the matter is not quite up to date, and many inaccuracies occur. Half-a-dozen pages at the end of the book are devoted to conversational matter, where the French and German are given for certain phrases which it might be useful for the soldier to know. A column is set apart for the French interpretation of the German

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pronunciation. For example, the German rendering of the French sentence, "Faites attention et dites-moi la verité, ou je vous emmène," is given thus :—"Passn Sî aouf! ound sagn Sî dî Waarhaït, odr Ich nême Sî mit!"

The book is in a handy pocket form, easily carried in the field.

THE TACTICAL EMPLOYMENT OF ELECTRIC SEARCHLIGHTS (Die Elektrischen Scheinwerfer in militärtaktischer Anwendung). By Capt. Josef Aggermann. 100 pp., with 31 diagrams. 8vo. Vienna, 1908. 5s.

The author, who is the commander of the searchlight section at the Austrian fortress of Pola, intends this volume to be a handbook for the *personnel* of searchlight units. At the same time he anticipates that it will be of use to officers of all arms, especially to those who may have searchlight units under their command.

The book begins with a description of the *matériel* and organization of searchlight detachments in sufficient detail to render the subsequent discussion as to the tactical employment of these units intelligible to the general reader.

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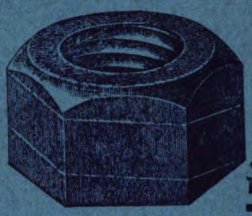

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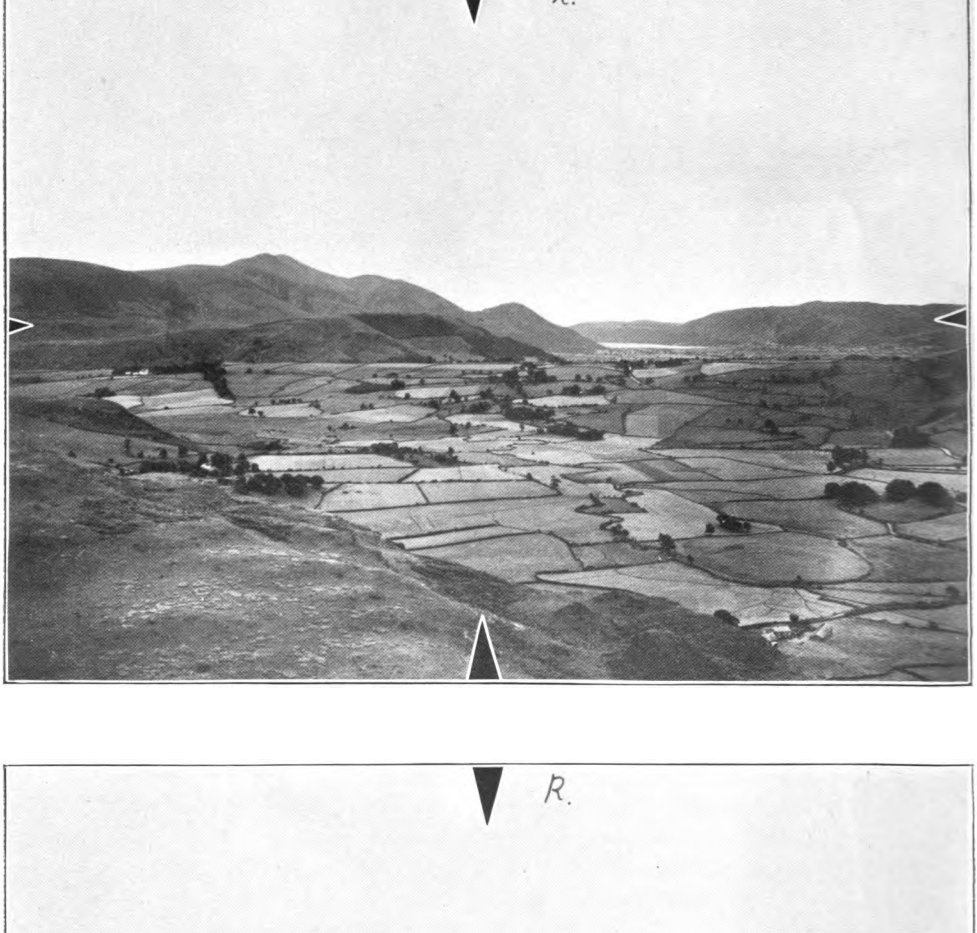

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STEREOSCOPIC PHOTOGRAPHY APPLIED TO RECONNAISSANCE AND RAPID SURVEYS.

By CAPT. F. V. THOMPSON, R.E.

APPLICATIONS of photography in the field have hitherto been chiefly confined to record work and map reproduction.

It is proposed to consider in this paper two further applications, viz. :—

1. Reconnaissance work.
2. Rapid surveys.

Before taking these in detail, it will be necessary to briefly describe the principles upon which these applications depend—

A.—Orthochromatic photography.
B.—Manipulation by time.
C.—Extended base stereoscopy.

A.—ORTHOCHROMATIC PHOTOGRAPHY.

The general tendency in modern out-of-door photography is to reduce it to a system of "button-pressing," the remainder of the work being as often as not carried out by the local chemist.

The result is somewhat of a toss-up and, at the best, will be a picture more or less pleasing from a scrapbook point of view, but quite useless for military purposes or survey work.

The essential part of a landscape from a military point of view is the middle and extreme distance (from 500 to 5,000 yards). In an ordinary photograph the middle distance fades off into the sky, whilst the extreme distance is probably entirely lost. The photograph fails to reproduce what the eye can see on the ground.

The reason for this is that the ordinary photographic plate is relatively colour blind compared with the human eye, and the object of orthochromatic photography is to correct this colour blindness, and to reproduce in the photograph all that can be seen by the eye. In other words, to give a correct rendering of colour luminosities throughout the view.

The greatest visual luminosity in the solar spectrum is near the yellow portion ; unfortunately this is the portion to which the ordinary photographic plate is least sensitive. The plate's greatest sensitiveness is in the blue and violet portion, consequently the predominance of bluish rays in the extreme distance, and of green and yellow in the

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middle distance, render it impossible to obtain an evenly exposed picture throughout, when using an ordinary plate.

The curves in *Fig.* 1 show approximately the relative sensitiveness of the normal eye and the ordinary plate, to the solar spectrum.

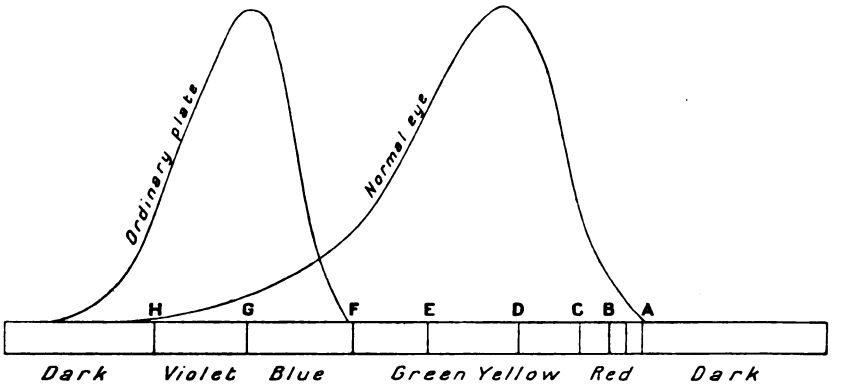

FIG 1.

A corrected result can be obtained by exposing the plate behind a suitable orange-yellow glass (called a "colour screen.") Owing however to the almost complete extinction of the blue and violet rays, and to the feeble sensitiveness of the plate to the yellow rays transmitted, the exposure will be increased more than a thousand times, and this is obviously impracticable.

A partial correction can be effected by the application of certain dyes to the plate. A plate so treated becomes an orthochromatic plate, and can be made moderately sensitive to the yellow portion of the spectrum. To obtain complete correction it is necessary to further subdue the effect of the blue and violet rays; this is effected by an orange colour screen which will increase the exposure from 15 to 20 times. By this combination of orthochromatic plate and colour screen it is possible to obtain correct visual colour luminosities throughout the view.

Half measures must be avoided, but have been encouraged by the manufacture of snap-shot orthochromatic plates and low value colour screens, increasing exposure only 2 to 5 times. The result is a poor compromise, but the existence of such gear is rendered necessary by the prevailing craze for "button-pressing." Useful results can only be obtained by using a moderately slow orthochromatic plate, and a properly adjusted colour screen, giving complete correction.

For this work a tripod or some kind of rest is inevitable, and this being so, it is a small matter whether the exposure is 2 seconds or 20 seconds. The longer exposure is in fact preferable, as it can be more accurately timed. Another advantage of a longer exposure, is that the aperture or stop of the lens can be reduced so as to give the sharpest possible definition. Incidentally a rather cheaper lens can

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be used, as the expensive nature of modern lenses is chiefly due to the "button-pressing" requirement of large aperture combined with sharp definition; the result has however been a considerable advance in lens construction generally.

The orthochromatic result, though truthful, is not always artistically pleasing, and at first sight has an unnatural appearance of contrast and detail, and lacks "atmosphere." Any displeasing effect is partly due to the fact that the normal eye has become demoralized through seeing so many untruthful results, and fails to appreciate truth when presented to it.

B.—MANIPULATION BY TIME.

For reconnaissance and survey work the photographic manipulations have been reduced to a system which, when followed, renders the chances of failure remote, and may be described as "fool-proof."

A systematic procedure is essential, as it may often happen that the officer required to carry out the fieldwork or exposure of plates has had little experience of photography. Ordinary care is the only necessary qualification, though of course a good eye for country is essential for the economical selection of views.

The development and further operations require some skill and greater care, but are quite systematic.

The work may be divided into three stages :—

(*a*). Exposure of plates.
(*b*). Development of plates.
(*c*). Preparation of enlargements or transparencies for the stereoscope.

In reconnaissance work (*a*) would be carried out by an officer, (*b*) and (*c*) by a trained photographer. In survey work (*a*) and probably (*b*) would be carried out in the field by the camera party, consisting of one surveyor and one photographer assistant; (*c*) and the plotting would be done in an office.

Each stage has been reduced to a matter of timing by simple calculation.

(*a*). EXPOSURE OF PLATES.

In the first place no focussing is required. The time of exposure is calculated by means of an exposure meter, the essential feature of which is a strip of sensitized paper placed alongside a standard tint.

The time taken by the light in changing the colour of the sensitized paper to match the standard tint is a measure of the light intensity. The constants are the speed of the plate, the aperture or stop of the lens, and the density factor of the colour screen. A sliding scale gives the required exposure, or the necessary stop for any desired length of exposure.

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(*b*). DEVELOPMENT OF PLATES.

The majority of failures by amateur photographers are probably effected in the dark room, with the aid of a ruby lamp. If a dark room is used at all there should be no form of illumination during development, or only one which has been carefully adjusted to, and tested for the plate in use. In the field a dark tent, unless it can be erected in a building or shed, is an abomination and has been discarded in favour of a combined developing and enlarging box. Failing this a collapsible form of changing bag with light-tight sleeves can be used.

Development is carried out by time, which varies with the nature and strength of developer, brand of plate, and temperature of developer. When temperature is the only variable, the time of development can be ascertained from a table of temperatures. Tabloid developer is employed.

(*c*). PREPARATION OF ENLARGEMENTS OR TRANSPARENCIES.

Either of these can be prepared in the field developing and enlarging box, mentioned above, by daylight or by artificial light as required.

These operations (*b*) and (*c*) require more skill than (*a*) and would usually be carried out by a skilled photographer. In skilled hands a pair of finished enlargements $10'' \times 8''$ can be turned out, under favourable conditions, in half an hour from the time the dark slides containing the exposed plates are handed to the operator at the box.

Space forbids a description of the box and its manipulation.

C.—EXTENDED BASE STEREOSCOPY.

It is not proposed here to enter into a discussion on stereoscopic vision, but to describe an application of stereoscopy to landscape photography, which does not appear to have been practised hitherto.

The ordinary stereoscopic prints seen are taken in a camera provided with two lenses mounted about $2\frac{1}{2}$ inches apart, this being the normal interocular distance. The relief effect seen in the stereoscope is consequently no greater than that seen by normal eyes in nature.

Assuming one minute of arc to be the defining or separating power of normal eyes, relief is not appreciated beyond a range of about 250 yards. Beyond this range there is some appearance of relief due merely to familiarity with the objects seen and not to convergence of the optic axes.

By extending the stereoscopic base from $2\frac{1}{2}$ inches to 4 feet, the limiting range of relief effect would be increased from 250 to approximately 5,000 yards. A single lens camera would be used, and moved to one side or the other for the second exposure.

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To obtain full advantage of the extended base principle, it is found advisable to use a base varying from 10 to 100 yards, according to the subject and purposes for which the view is required.

A 10-yard base will give at 2,000 yards a relief effect equal to that seen by normal eyes at 14 yards, that is to say the parallactic angle or the angle subtended at the object by the stereoscopic base is the same in the two cases.

The appearance in the stereoscope when properly adjusted should give no distortion of perspective but exaggerated relief, such as would be seen by an individual whose eyes were separated by a distance equal to the stereoscopic base. The appearance corresponds to that of a model of the country viewed from the point on the model occupied by the camera on the ground, thus giving an equal amount of detail and increased relief.

There is, as might be expected, some discomfort experienced in combining stereoscopically objects which are distant less than twice or three times the base length. A sensation of squinting results, similar to that experienced when viewing an object placed only 5 or 6 inches from the eyes. This point need not be considered except in the case of very long bases, or when it is required to view objects at short range.

The relief effect in the distance is very pronounced, small folds in the ground, which cannot be detected by the aid of field glasses, being thrown into marked relief. The contour of the ground is shown in a way unequalled by any other optical instrument.

An important fact stated by Professor Forbes is that a single stereoscopic observation is more precise than two separate monocular observations. This fact was independently noticed in the S.M.E. experiments, the probable errors giving a ratio of 5:3.

The result is equivalent to a proportionate increase in definition, and is very appreciable in the case of a pair of views taken perhaps on a hazy day.

On examining the views separately it might be impossible to determine the shape of distant ground, but on viewing them in the stereoscope, patches of "woolly" and uncertain definition assume definite shape and outline, and are thrown into their respective planes of relief.

APPLICATIONS.

1. RECONNAISSANCE WORK.

It is assumed that this class of work is supplementary to an existing small scale map.

The reconnaissance work usually required may be :—

(*a*). Reconnaissance of an enemy's position and approaches,
(*b*). Reconnaissance of a position for defence, or
(*c*). Route reconnaissance.

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Of these it will be sufficient to consider (*a*), as the procedure adopted can be applied to (*b*) or (*c*), though perhaps not so advantageously.

RECONNAISSANCE OF AN ENEMY'S POSITION.

The usual methods of executing this reconnaissance are :—

(1). A rapid prismatic compass or plane-table sketch from a distance by intersections,
(2). Range finder and prismatic compass sketch,
(3). Eye sketch by estimation of distance, or
(4). Panorama sketch.

It is doubtful whether (1) or (2) often go far to elucidate the small scale map, whilst the personal factor must always enter too largely into (3) and (4) to allow either to inspire much confidence.

Where the above methods fail, is in indicating the true shape of the ground, and it is thought that stereoscopic views, taken on the extended base principle, would, by presenting the appearance of an exact model of the country in bold relief, often go further in elucidating the small scale map than (1) or (2) above, and inspire considerably more confidence than (3) or (4).

The stereoscopic method is not advocated as an invariable substitute for the older methods, but as one which would in hilly country often give more useful results and in any case prove a valuable supplement.

The first consideration in selecting gear for this work is the amount of detail or definition obtainable in the views.

It is generally known that an enlargement, to say two diameters, from the best of negatives, though approximately equal to a twice magnified view of a contact print, is much inferior in definition to a contact print from a negative of twice the magnification (*i.e.*, a negative taken with a camera lens of twice the focal length).

This is due to the unavoidable granular structure of the negative film in which much of the finer detail becomes lost. Some detail is lost in the negative itself, more in the smaller negative than the larger. There is a further loss in enlargement owing to diffusion due to grain in the plate.

As there was no standard of definition it was decided to adopt normal vision as a standard for experimental purposes. The object of this was to enable direct comparison to be made between the detail to be found in a negative and field glass or telescope powers.

The defining or separating power of the normal eye is approximately one minute of arc. From experiments made with test screens, a standard combination of lens, stop, plate, and developer was arrived at.

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The conclusion reached was that a good 6-inch focus lens at f.32 gave unit definition, and that an increase in focal length gave a nearly proportionate increase in definition.

From this it follows that if detail in the negative were required equal to that seen in nature with a telescope of say power 4, it would be necessary to use a camera lens of $4 \times 6'' = 24''$ focal length. This would necessitate a camera rather over 2 feet in length. There is however a gain of 5:3 in the stereoscope, so that if the extended base method is employed a lens of $\frac{3}{5} \times 24'' = 14{\cdot}4''$ would suffice. This would mean a camera about 16 inches long.

The next consideration is the size of plate, and for ordinary field use $5\frac{1}{2}'' \times 3\frac{1}{2}''$ is considered the most suitable size.

Having fixed the size of plate, the angle of view included and dimensions of camera are determined by the focal length of the lens, which in its turn depends on the definition required.

The following table gives the definition, angle of view, length of front covered at 3,000 yards, and length of camera for lenses of varying focal lengths, using $5\frac{1}{2}'' \times 3\frac{1}{2}''$ plate and the extended base method :—

TABLE I.

	Focal length in inches	Definition	Angle of view	Frontage at 3000 yds.	Length of Camera
1	5	1·4	57°·40′	3300	·7″
2	6	1·7	49° 20′	2760	·8″
3	7	1·9	43°·	2340	·9″
4	8	2·2	38°·	2040	·10″
5	10	2·8	30°·40′	1650	1′·0″
6	14	3·8	22°·	1176	1′·4″
7	30	8·0	10°·40′	552	2′·8″

Selection of Focal Length.—A short focus lens means economy in time, plates, bulk, weight, and cost of camera.

The economy in bulk and weight can however be effected by using a telephoto lens which is arranged to have an equivalent focal length considerably greater than the length of the camera. The definition

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corresponding to the angle of view is however less, *e.g.*, in case (7) above, by using a telephoto lens the length of camera could be reduced from 2 feet 8 inches to about 9 inches, but the definition would be considerably less than 8, chiefly due to optical imperfections.

For the use of officers in the field a camera longer than 9 inches becomes too cumbersome, consequently the most convenient combination is a 6-inch lens and an interchangeable telephoto lens of 30 inches equivalent focus. By this means general views of a position can be taken covering a front of 2,760 yards at a range of 3,000 yards, and showing 1·7 times the detail seen by the unaided eye. By changing lenses a detailed view can be taken of any particular portion covering a front of 550 yards at a range of 3,000 yards, and showing approximately the same amount of detail as seen with the aid of field glasses of power 6.

Selection of Camera.—In exposed situations, and when time is a consideration, focusing is out of the question. Even under favourable conditions it would be difficult, since the focus of the rays transmitted by the colour screen would not coincide with the visual focus, whilst focusing with the screen in position would be difficult on any but bright days.

Any ordinary rigid form of camera could be adapted for stereoscopic work, if provided with a firm tripod.

For Service requirements however where reliability and rapidity are essential, a specially-constructed camera is required. The following are the essential features :—

The camera should be of the fixed focus box type. Sliding parts must be avoided, as extreme accuracy of focus is required, particularly for the telephoto lens. The camera cannot, of course, be used for near objects, and the focus must be most carefully adjusted by the maker, with colour screen and stop in position.

A light metal body is advocated, and metal-faced double dark slides provided with strong internal springs to ensure the film side of the plate being always in the focal plane.

The size of the camera is approximately $9'' \times 7'' \times 4\frac{1}{2}''$. On its upper surface are a circular level and sighting lines (see *Fig.* 3).

On the inside of the camera, and as near to the dark slide as possible, are four small metal triangular projections or pointers, so placed opposite to one another that lines joining them, when the camera is levelled, are respectively vertical and horizontal, and intersect on the axis of the lens. The shadows of these small pointers imprint themselves on the edges of the negatives, and provided the camera is levelled at each exposure, save all trouble in adjusting the views later in the stereoscope.

The rear end of the camera is provided with a leather cap, which fits closely over the dark slide, as the best dark slides will not stand a long exposure in sunlight if unprotected.

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The shutter is a simple flap at the back of the lens, and is operated by an antinous release.

The colour screen is attached to the back of the lens.

The tripod should be a stout one, slightly lighter than the 3-inch theodolite pattern, and provided with a ball and socket head, the head being protected by a leather cap.

The advantage of the ball and socket head is that the camera can be quickly aimed and levelled, and admits of a simple subsidiary aiming and levelling attachment for performing all the necessary operations from a lying-down position, a convenience in exposed situations.

The total weight of the apparatus described above, including camera, six double dark slides loaded, tripod and leather cases, amounts to approximately 13 lbs.

For precise work solid gear is essential, particularly in rough weather, and at any time when using a telephoto lens.

THE STEREO-CASE.

The pattern of stereoscope adopted is an extension of that invented and patented in France by M. Pigeon.

The chief advantages of this form are :—

1. Portability. It can be folded up flat.
2. Simplicity. There are no optical parts with the exception of a small plane mirror.
3. Views of any size can be stereoscopically combined.

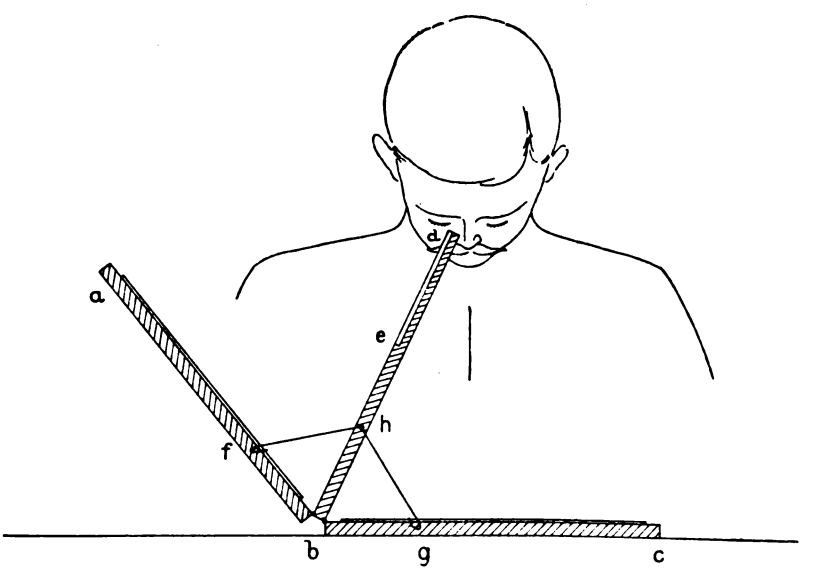

FIG. 2.

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ab, *bd*, *bc* are three leaves of wood or aluminium hinged at *b*.

The views are laid on *ab*, *bc*, and are held in position by clips. They are adjusted by bringing the reference marks into line with corresponding marks on the leaves.

The centre leaf, *bd*, has a piece of plane mirror at its outer end, facing *ab*. This centre leaf is held in a position bisecting the angle between the two outer leaves by means of stays, *fh* and *gh*. The left-hand view of the pair is placed on *bc*.

A reversal of the right-hand view is placed on *ab*. The method of observing is shown in the figure. It is obvious that a reversed image of the view on *ab* will be seen by the right eye, and will be superimposed on the view seen by the left eye. The result is stereoscopic combination.

The view on *bc* is carried on a slide having some lateral play. This allows an adjustment to be made for comfortable combination in the case of abnormal observers and base lines.

The views employed are enlargements, about $10'' \times 7''$, and can be turned out in the field enlarging and developing box from the $5\frac{1}{2}'' \times 3\frac{1}{2}''$ negatives.

The reversal is obtained by reversing the negative concerned in its holder during enlargement.

Contact prints could not be used, but contact transparencies could be employed, and would give finer detail. One view must in this case be placed face down, and the leaves of the stereo-case must be hollowed out, so that the views can be seen by transmitted light.

The negatives themselves can be viewed in this way, but the light and shade is rather confusing at first sight.

For Service requirements, enlargements are considered the most suitable form of view, as they can be quickly prepared from wet negatives. Reversal is simple ; they obviate the necessity for magnifying arrangements in the stereoscope, and a number of views can be packed in the stereo-case.

Transparencies might be used if there was no enlarging gear available.

MAKING EXPOSURES FOR THE STEREO-CASE.

It is desirable to expose the two plates in the same vertical plane, but the human eye possesses such powers of accommodation that considerable latitude is permissible, and elaborate sighting arrangements such as are required in photo-surveying are in this case unnecessary.

It is sufficient if the two plates are exposed in planes which are approximately parallel, and separated by a distance which should be negligible, compared with the range of the nearest portion of the position to be observed.

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Fig. 3 shows the necessary sighting lines on the upper surface of the camera.

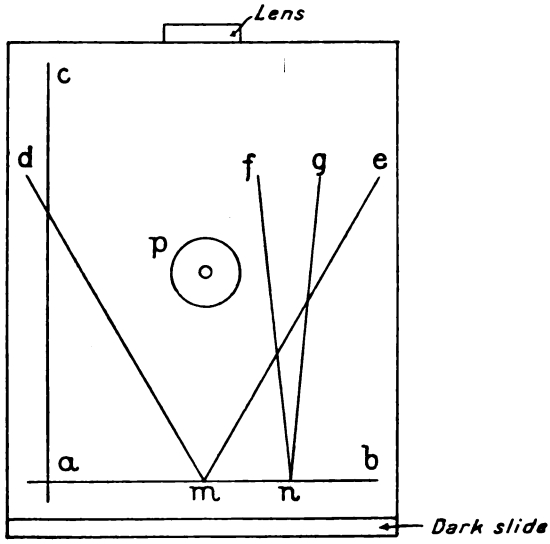

FIG. 3.

ac gives the direction of the axis of the lens.
ab gives the direction of the base line.
dme gives the limits of the view included by the 6-inch lens.
fng gives the limits of the view included by the telephoto lens.
p is a circular level.

The following is the procedure adopted :—

1. Take the light value by exposure meter, using watch or improvised pendulum swinging seconds. In very strong lights place a pale yellow glass of known density over the exposure meter and observe through this. Calculate exposure. If less than 5 seconds at f.32 decrease aperture of lens sufficiently to lengthen exposure to 5 seconds or more.
2. Set up camera, level and direct by means of sighting lines so as to include the required view. Make exposure.
3. Sight along *ab* (*Fig.* 3) and pick up some object as far off as possible, walk along this line and again set up camera, level and again sight along *ab*, turning camera till *ab* is again on the distant point. Make second exposure.

It sometimes happens that owing to obstacles the second camera station must be moved back or brought forward a few yards. Concealment and provision of cover may impose a narrow limit on the choice of camera stations. Sometimes it may not be possible to pick up a distant object to a flank.

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In such cases neglect the sighting line *ab* and use *ac* as follows :—

(1). From any possible position make an exposure including the desired view, and pick up some object as far off as possible along the line *ac*.

(2). From the best available position to either flank make a second exposure, seeing that *ac* is again directed on the distant object.

A difference in level between the two ends of the base is immaterial.

If possible avoid a foreground (up to 200 yards) such as an under-feature, trees, houses, etc., which mask or nearly mask any important portion of the distance. Such objects will cause discomfort in the stereoscope, and may by obtrusion make stereoscopic combination difficult in the distance. If such objects cannot be avoided use a short rather than a long base.

In hilly country there is seldom a difficulty in obtaining a view unobstructed by foreground.

In gently undulating country, well covered with trees and hedges, anything approaching a long base (50 yards and over) will be out of the question unless some commanding position is available, and it may be necessary to use short bases, 5 to 10 yards. The relief effect in the extreme distance will then be small.

When using the telephoto lens, presumably detail is required in the extreme distance, and a long base of 100 yards or more should be used.

The Photo shows a pair of views taken with a 6-inch lens and base of approximately 60 yards. The right hand view is reversed.

2. RAPID SURVEYS.

A brief outline only can be given here of this application of stereoscopic photography. A detailed description of the method and an account of some experimental work, executed in the Cumberland Lake District in August, 1907, will be found in *The Geographical Journal*, May, 1908.

The method is peculiarly suitable for small-scale and exploration work in hilly countries. Compared with plane-tabling there is considerable economy in time, but some sacrifice in accuracy.

Fieldwork.—The general procedure is similar to that already described, but more precise. The camera is provided with accurate levels and a small sighting telescope, so that both plates can be exposed in the same vertical plane. The stereoscopic base is measured by a stretched wire or a subtense bar. Where a close network of triangles exists, or when two fixed points can be included in a view, base measurement can be dispensed with.

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The total weight of the new field equipment now in course of construction will be approximately 25 lbs. in two equal loads. A camera party would usually consist of one surveyor and one photographer assistant. The triangulation and photography can, if desired, be run concurrently by one party.

On a 1-inch to 1-mile scale an average of 2 square miles per view pair should be obtained. The exposure of 12 to 18 plates in rocky country would be a good day's work if the views were economically selected. Each view pair, including unpacking, exposure, base measurement, and repacking, occupies 20 to 30 minutes in the field. Bases of 200 to 300 feet and more are usual, according to the accuracy required.

It is desirable that the plates should be developed as the work proceeds. This involves a very small increase in weight of equipment, a leather developing bag being used in place of a dark room. The surveyor works with more confidence and can examine the negatives in a stereo-case if desired.

Office Work.—The plotting is done by means of an instrument which has been called a "stereo-plotter." This is a stereoscope and plotting board combined.

Contact transparencies from the negatives are inserted and adjusted. Ranges are read on a spirally-graduated drum on a similar principle to the Forbes Stereoscopic Range Finder. A sliding rule is set at this reading. The position of the point in plan and its height in feet are then automatically indicated on the board.

An adjustment is made in the instrument for any difference in level of the ends of the base.

With practice 150 points per hour can be plotted. In the new instrument this rate should be increased. The speed of plotting depends on the scale and nature of country, as these determine the number of points to be plotted per square mile. Assuming that 12 to 18 plates are exposed per diem by the camera party, plotting at 1 inch to 1 mile should keep pace with them. The slow speed of plotting has hitherto been the chief drawback to photo surveying.

Contouring by this new method is particularly easy, owing to the exaggerated relief effect.

The following table gives some idea of the accuracy to be expected. The new gear should give considerably smaller instrumental errors than those on which this table was based :—

DATA FOR TABLE OF ERRORS.

Camera Lens, 6-inch Focus.

(1). Probable error in alignment = 20 sec. arc.

(2). Probable error in reading of parallax and setting of plates and scale in stereo-plotter = 0·0012 inch.

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(3). Probable error in rapid base measurement $=\frac{1}{400}$,

a = error in range due to (1)

$$= \frac{(\text{range})^2 \times 20 \sin 1 \text{ inch}}{\text{base}}$$

p = error in range due to (2)

$$= \frac{0{\cdot}0012\ (\text{range})^2}{\text{base} \times 6 \pm 0{\cdot}0012\ (\text{range})}$$

b = error in range due to (3)

$$= \frac{(\text{range})}{400}$$

$$\text{Mean error} = \sqrt{a^2 + p^2 + b^2}$$

TABLE OF ERRORS.

Range.	Base 100.			Mean Error.	Base 200.			Mean Error.	Error in Height.	
	a	p	b.		a	p	b		Base 100.	Base 200.
500	0·2	0·5	1·2	1·2	0·1	0·2	1·2	0·5	0·2	0·3
1000	1·0	2·0	2·5	3·2	0·5	1·0	2·5	2·7	0·6	0·5
1500	2·2	4·5	3·7	6·2	1·1	2·2	3·7	4·2	1·2	0·8
2000	4·0	8·0	5·0	10·2	2·0	4·1	5·0	6·8	2·0	1·4
2500	6·2	12·6	6·2	15·3	3·1	6·3	6·2	9·3	3·1	1·9
3000	9·0	18·1	7·5	21·5	4·5	9·0	7·5	12·0	4·3	2·4
3500	12·7	25·7	8·7	29·9	6·4	12·9	8·7	16·8	6·0	3·4
4000	16·0	32·2	10·0	37·3	8·0	16·2	10·0	20·6	7·5	4·1
4500	20·2	40·8	11·2	46·9	10·1	20·4	11·2	25·3	9·4	5·1
5000	25·0	50·5	12·5	57·7	12·5	25·1	12·5	30·8	11·5	6·2
6000	36·0	72·5	15·0	82·3	18·0	36·2	15·0	43·1	16·5	8·6
7000	49·0	99·0	17·5	112·2	24·5	49·5	17·5	57·0	22·4	11·4
8000	64·0	130·0	20·0	146·2	32·0	65·0	20·0	75·1	29·2	15·0
10000	100·0	204·0	25·0	228·0	50·0	102·0	25·0	116·3	45·6	23·3

Focal length of camera lens = 6 inches.

(a) *p.e.* in alignment = 20 seconds of arc.

(p) *p.e.* in reading of parallax = 0·0012 inch.

(b) *p.e.* in base measurement = $\frac{1}{400}$.

100 yards on scale 1 inch to 1 mile = 0·057 inch.

Note.—Errors in height are calculated for points at a mean elevation or depression of 10°.

From the above table and formulæ the degree of accuracy for any set of conditions can be determined, or any required degree of accuracy ensured by variation in the length of stereoscopic base and focal length of camera lens.

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*ORGANIZATION OF THE MOUNTED UNITS OF THE ROYAL ENGINEERS.**

By COLONEL A. G. DURNFORD, LATE R.E.

IN the *R.E. Journal* for August, an article by Colonel Ward appeared dealing with the First Mounted Units of the Corps organized at Chatham, and the following short sketch of *all* the mounted units up to the present time, may therefore prove of interest, especially to those officers who have served in them.

The first mounted unit was the "23rd or Driver Company of the Royal Sappers and Miners," raised at Woolwich in April, 1855, under the command of Capt. Siborne, its establishment being—5 officers, 130 N.C.O.'s and men, 120 horses.

The company embarked for the Crimea in August, 1855, but peace having been declared during the voyage it was landed at Scutari. Its name was at about this time changed to "R.E. Field Equipment," and subsequently to "R.E. Train." It returned home in 1856, disembarking at Woolwich in September of that year, and proceeded to Aldershot, where it took over the wagons and equipment of the Engineers of the Turkish Contingent. It was employed on ordinary Corps duties, generally at Chatham in the winter, and at Aldershot in the summer months.

On field days small infantry pontoons were carried almost loose in the ordinary entrenching tool wagons, subsequently the heavy Blanshard pontoons were adopted, carried on wagons of the Turkish Contingent Engineers which had been altered into pontoon wagons.

In May, 1863, the formation of an additional troop of R.E. Train and a depôt for the two troops was approved; these were called—

A. Pontoon Troop ...
B. Equipment Troop } R.E. Train.
Depôt ... ...

Capt. R. W. Duff, who had succeeded Capt. Siborne in command of the original A Troop, was appointed to command the R.E. Train.

In August, 1870, the formation of a third, C, or Telegraph Troop was approved.

* Full detailed information as regards these units up to 1889 will be found in the *History of the Corps of Royal Engineers*, by Major-General Porter, Vol. II., Chapter II.

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A (PONTOON) TROOP.

The original unit, as already described, continued as a pontoon troop and the only mounted unit, until 1863, when the formation of an additional troop and a depôt was approved.

In 1863 the establishment was :—

1 Captain,
3 Lieutenants,
207 N.C.O.'s and men,
5 officers' horses,
12 riding, 80 draught } troop horses,
12 pontoon wagons (24 pontoons),
1 spare pontoon wagon,
3 general service wagons,
1 forge wagon,
1 boat wagon,
1 artificers' wagon,
1 store cart.

The length of bridge carried was 100 yards, the pontoons being an improved pattern of the Blanshard pontoon.

In 1864 the establishment was raised to :—

4 officers,
217 N.C.O.'s and men,
5 officers' horses,
16 riding, 124 draught } troop horses.

In 1870 the Blanshard pontoon was abandoned and the boat pontoon adopted, the length of bridge carried was 100 yards of floating bridge and 20 yards of trestle bridge, the carriages being 20 pontoon wagons—carrying pontoons and superstructure—4 pontoon wagons—carrying trestles and superstructure—5 store wagons (R.E. pattern), 1 forge wagon (R.E. pattern), 1 office wagon (R.E. pattern).

In 1888 the title was changed to Bridging Battalion, subdivided into A and B Troops.

The war establishment of each troop was :—

1 Major or Captain,
2 Lieutenants,
211 N.C.O.'s and men,
6 officers' horses,
14 riding, 168 draught } troop horses,
20 pontoon and trestle wagons,
7 general service wagons,
1 forge wagon.

In December, 1896, A and B Troops became separate units. In 1899 a third, C Troop, was added, and in 1900 a fourth, D Troop. This latter troop was disbanded in 1902. In May, 1905, A, B, and C Troops, Bridging Battalion, were renamed as 1st, 2nd, and 3rd Bridging Companies. In April, 1907, the three Bridging Companies, strength 314, were reduced, and replaced by three Bridging Trains with a strength of 24. The 1st Bridging Company was mainly transferred to the Telegraph Companies, and the 2nd and 3rd Bridging Companies were converted into the 5th and 4th Field Troops respectively.

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B (EQUIPMENT) TROOP.

On the 5th May, 1863, the formation of an additional troop of the R.E. Train was approved to be called the "B, or Field Equipment, Troop."

This troop carried the field equipment for three companies, and was divided into three sections and a Field Park, one section to be attached to a company for field service or as required.

The establishment of the troop was :—

1 Captain,	16 riding	troop horses,
3 Lieutenants,	78 draught	
191 N.C.O.'s and men,	20 pack	
5 officers' horses,		

the carriages being

3 forge carts,	6 general service wagons,
4 store carts,	1 forge wagon,
15 tip carts,	1 miners' wagon.
3 artificers' wagons,	

In 1864 the establishment was raised to :—

1 Captain,	20 riding	troop horses.
3 Lieutenants,	112 draught	
217 N.C.O.'s and men,	30 pack	
5 officers' horses,		

In time the disadvantages of the plan of attaching a section from another unit to a company for purposes of war or manœuvres, became apparent, and in November, 1877, the troop was broken up, its horses and drivers being transferred to four companies of the Corps which were then called "Field Companies." Wagons were substituted for the carts previously used, and the number of pack horses reduced, the equipment of each Field Company being carried in 6 wagons and on 3 pack horses. The Field Park was attached to the Depôt. In 1885 two additional Field Companies were formed, and they have since been increased to fifteen.

C (TELEGRAPH) TROOP.

The formation of "C, Field Telegraph, Troop" was approved from the 1st September, 1870. It was formed at Chatham on one section (Lieut. Tisdall's) of B Troop. Its establishment was :—

1 Captain,	6 officers' horses,
4 Lieutenants,	55 troop horses.
245 N.C.O.'s and men,	

the carriages being

4 office wagons,	1 pontoon wagon,
12 wire wagons,	1 forge wagon,
3 general service wagons,	3 artificers' wagons.

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The equipment consisted of 36 miles of insulated cable (each wire wagon carrying six drums with half a mile of cable on each; the wire was three strands of No. 20 B.W.G. copper wire insulated with vulcanized india rubber, over which was laid a layer of canvas and two thicknesses of tape primed with india rubber) and the other instruments and stores. Twenty of the drivers were equipped as mounted signallers. In August, 1871, the troop was transferred to Aldershot, and the establishment of horses raised to 115.

The inconvenience of working with cable alone was felt very early, and experiments as to the lightest and most suitable air-line equipment were carried on for a considerable time, and eventually an air-line equipment was adopted.

On April 1st, 1884, C Troop and the 22nd and 34th Companies (Telegraph Companies employed under the General Post Office) were amalgamated under the name "The Royal Engineer Telegraph Corps," which was formed of two Divisions, C Troop being the 1st, and the two companies the 2nd. Two months later the name was changed to "Telegraph Battalion, Royal Engineers."

In 1889 an air-line section carried 20 miles of overhead wire, 2 miles of outpost cable and apparatus for three offices; a cable section carried 20 miles of cable and apparatus for three offices.

The War Establishment for two army corps was at that time headquarters and eight sections, which, including a strength of 55 for "duty at home," numbered

21 officers,	59 riding	troop horses.
716 N.C.O.'s and men,	248 draught	
20 officers' horses,		

In April, 1900, a 3rd Division of the Telegraph Battalion was formed at Aldershot. In November, 1901, the 1st Division, South African Field Force, was subdivided into two divisions. In April, 1903, the 3rd Division became the 2nd Division, and cadre of new 3rd Division was attached to 1st Division. In May, 1905, the name Telegraph Battalion was abandoned, and the units numbered as Telegraph Companies. In April, 1907, the Telegraph Companies were reorganized into

2 air-line companies	...	strength, 258	N.C.O.'s and men.
2 cable companies	...	" 144	" " "
7 divisional companies (three are cadres only)	...	" 139	" " "
2 wireless companies	...	" 92	" " "
	Total	633	

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FIELD TROOPS.

The first employment of mounted Engineers was during the Egyptian War of 1885, when a detachment of 1 officer, 1 sergeant, and 26 men taken from the 11th (Field) Company were mounted—30 horses being provided—and attached to the mounted infantry. A short account of the doings of this detachment appeared in the *R.E. Journal* for July, 1885.

This proved so successful an experiment that in 1888, as a result of the recommendations of a War Office Committee (Major-General D. C. Drury-Lowe President), the formation of a Mounted Detachment was approved as a branch of the Field Depôt at Aldershot.

The peace establishment was :—

1 officer,
1 sergeant,
2 corporals,
1 trumpeter,
24 sappers,
8 drivers,
28 riding, 8 draught, 2 pack } troop horses,

with 1 small arm ammunition wagon and 2 forage carts.

In 1889 the war establishment of the Mounted Detachment was :—

1 Major or Captain,
3 Lieutenants,
113 N.C.O.'s and men,
8 officers' horses,
81 riding, 24 draught, 6 pack } troop horses,

with 3 S.A.A. wagons and 6 forage carts.

In 1894 the "Mounted Detachment" was made a separate unit distinct from the Field Depôt. On the 1st July, 1899, the name of "Mounted Detachment" was changed to "Field Troop."

In 1900, during the late South African War, two additional Field Troops were raised, and on the 15th April, 1907, when the Bridging Companies were reduced, two more were formed.

The war establishment of a Field Troop at the present time is :—

1 Captain,
2 Lieutenants,
81 N.C.O.'s and men,
41 riding, 35 draught, 5 pack } troop horses,
2 double tool carts (R.E. pattern),
2 spring wagons, Field Troop,
1 wagon for collapsible boat,
1 wagon, general service, for technical stores,
1 water cart.

Note.—Field troops were employed with conspicuous success in the late South African War. Two striking instances of the use of mounted Engineers were the cutting of the railway lines above Bloemfontein and north of Kroonstad. These are described in *The Times* of June 5th, 1900, and June 9th, 1900.

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MILITARY BALLOONS.

The first suggestion for the use of balloons in the British Army is due to Lieut. G. E. Grover in 1862, seconded by Capt. F. Beaumont, and these two officers were made Associate Members of the Ordnance Committee to carry out experiments, etc.

The details of the experiments made, the experience gained, and the growth of the Balloon Establishment are very clearly shown in *The History of the Corps of Royal Engineers*, by Major-General Porter, Vol. II., pp. 189—195, and in a Paper "Military Ballooning in the British Army," by Colonel C. M. Watson, C.B., C.M.G., in Volume XXVIII. of the *Professional Papers*, p. 39. The following notes are taken chiefly from these two sources :—

In 1878 the first military balloon, "The Pioneer," was built, the second and third, "The Sapper" and "The Heron," in 1883. In 1884 a small number of N.C.O.'s and men were trained as a Balloon Detachment, and in the same year a detachment of 10 N.C.O.'s and men, under Major Elsdale, R.E., and Lieut. Trollope, Grenadier Guards, went to South Africa to join the Bechuanaland Expedition, under Sir Charles Warren. In 1885 a detachment was sent to Suakin to join the force under Sir Gerald Graham ; this consisted of Major Templer, K.R.R., Lieut. Mackenzie, R.E., and eight N.C.O.'s and men.

In 1887 Major Templer was appointed Instructor in Ballooning.

In 1888 the Balloon Establishment was :—

1 officer in charge,
1 instructor in ballooning.

Balloon Detachment.

1 Lieutenant,
1 sergeant,
15 rank and file.

Balloon Factory.

1 military mechanist,
1 civilian gas maker,
1 „ storeman,
1 „ driver,
10 balloon making hands.

The carriages were :—

1 balloon wagon with hauling down gear,
3 tube wagons each carrying 44 tubes,
1 equipment wagon with spare balloons and stores,
1 water cart.

No horses were provided, the wagons being horsed when required by one of the field companies.

In 1890 a balloon section was authorized as a permanent unit of the Corps, its establishment being :—

3 officers,
3 sergeants,
28 rank and file.

In this year the Balloon Establishment was removed from Chatham to Aldershot.

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In 1892 the War Establishment of a section was :—

3 officers,	1 G.S. wagon, R.E. Balloon,
3 staff-sergeants,	1 „ „ „ Equipment,
47 N.C.O.'s and men,	4 wagons, gas reservoir,
6 officers' horses,	2 forage carts.
3 riding, 32 draught } troop horses,	

In 1897 Lieut.-Colonel Templer was appointed Superintendent of the Balloon Factory, directly under the orders of the Inspector-General of Fortifications, the instructional work being taken over by the Officer Commanding the Balloon Section.

In 1899 a second balloon section was formed, and with the first proceeded to South Africa. In December, 1899, Colonel Templer went to South Africa in command of the steam road transport train, and Lieut.-Colonel J. R. L. Macdonald was appointed Acting Superintendent of the Balloon Factory.

Early in 1900 a third balloon section was formed, and, later in the year, a fourth, for service in China, under Lieut.-Colonel Macdonald, his place as Acting Superintendent of the Balloon Factory being taken by Major Trollope.

In 1900 the War Establishment of a section was—

3 officers,	1 G.S. wagon, R.E. Balloon,
3 staff-sergeants,	2 „ „ „ Equipment,
53 N.C.O.'s and men,	6 wagons, gas reservoir,
6 officers' horses,	1 forage cart.
4 riding, 42 draught } troop horses,	

Early in 1901, the balloons being no longer required for service in South Africa, the sections were transferred to other duties, the 1st becoming the 3rd Field Troop, the 2nd the 2nd Field Troop, the 3rd joining the Railway Companies.

In 1901 Colonel Templer resumed charge of the Balloon Factory on return from South Africa.

In 1902 the Establishment was raised to five sections and a depôt. In 1905 the title Balloon Sections was changed to Balloon Companies.

The war establishment of a Balloon Company was : —

3 officers,	1 G.S. wagon, R.E. Balloon,
3 staff-sergeants,	2 „ „ „ Equipment,
62 N.C.O.'s and men,	6 wagons, gas reservoir,
6 officers' horses,	1 forage cart.
4 riding, 44 draught } troop horses,	

In 1906 the Balloon Companies were converted into the Balloon School, capable of turning out three companies on mobilization and two companies for training in peace. In April, 1906, Capt. W. A.

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de C. King was appointed Instructor in Ballooning. In May, 1906, Col. J. E. Capper, C.B., was appointed Commandant of the School and Supt. of the Factory vice Colonel Templer, appointed adviser to the War Office. In May, 1907, Capt. A. Carden was appointed Assistant Superintendent.

The present (1908) establishment of the Balloon School is :—

7 officers,	4 riding } troop horses,
1 warrant officer,	32 draught }
7 staff-sergeants,	3 G.S. wagons, R.E. Balloon,
129 N.C.O.'s and men,	6 „ „ „ Equipment,
	18 wagons, gas reservoir.

My thanks are due to Capt. Vesey and Capt. King for much valuable information and assistance in compiling these notes.

Lists of names of Commanding Officers of the above units, and of the Adjutants and Riding Masters of the R.E. Troops and Companies :—

COMMANDING OFFICERS OF R.E. TRAIN.

Capt. H. T. Siborne	1855-1860 (one Troop only)
Capt. R. W. Duff	1860-1863 (one Troop only)
Capt. R. W. Duff	1863-1871
Colonel FitzRoy M. H. Somerset ...	1871-1873
Colonel Sir H. C. Elphinstone, V.C., etc.	1873-1881. (During Sir H. Elphinstone's period of command the name was changed from R.E. Train to R.E. Troops).
Colonel A. R. Lempriere	1881-1882. (At this date the Command of the Troops and Companies at Aldershot amalgamated).
Colonel H. Helsham Jones	1882-1886
Colonel R. Athorpe	1886-1889
Colonel W. R. Slacke	1889-1891
Colonel Sir A. W. Mackworth, Bart....	1891-1894
Lieut.-Col. A. R. F. Dorward, D.S.O....	1894-1896
Colonel C. A. Rochfort-Boyd, C.M.G....	1896-1902
Colonel P. T. Buston, D.S.O.	1902-1904
Colonel J. L. Irvine	1904-1908
Colonel A. E. Sandbach, D.S.O. ...	1908

ADJUTANTS.

Lieut. H. Saville (from Sgt.-Maj., R.A.)	1855-1859
Lieut. M. Moore (appointed Q.M.S. to A Troop from the Turkish Contingent, and subsequently commissioned as Adjutant)	1859-1864
Lieut. A. K. Haslett	1864-1869
Lieut. Sir A. W. Mackworth, Bart. ...	1869-1873
Lieut. R. H. Jelf	1873-1878

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Lieut. J. C. MacGregor	1878-1879
Capt. H. V. H. Hart-Davis	1879-1883
Lieut. F. G. Bond	1883-1887
Capt. Sir R. W. Anstruther, Bart. ...	1887-1890
Lieut. W. G. Stairs	1890-1891
Capt. J. L. Irvine	1891-1895
„ A. E. Sandbach	1895-1896
„ H. B. Williams...	1896-1899
„ & Bt. Major G. P. Scholfield...	1899-1905
„ C. E. G. Vesey...	1905

RIDING MASTERS.

Capt. D. Gillon	1875-1894
„ J. E. Griss	1894

NAMES OF COMMANDING OFFICERS OF A (PONTOON) TROOP.

A Troop, R.E. Train.

Capt. H. T. Siborne	1855-1860
„ R. W. Duff	1860-1863
„ F. A. Marindin	1863-1865
„ R. N. Dawson (now General Dawson-Scott)	1865-1867
Major E. Micklem	1867-1876
Bt. Lieut.-Colonel R. Harrison ...	1876-1879
Major R. J. Bond	1879-1886
„ J. Gore-Booth	1886-1887
„ G. Barker	1887-1888

Bridging Battalion.

Major G. Barker	1888-1892
„ E. Dickinson	1892-1895
„ J. L. Irvine	1895-1896

**A Troop, Bridging Battalion.*

Major J. L. Irvine	1896-1902
Bt. Major G. A. Travers	1902-1905
„ G. P. Scholfield	1905-1906
2nd Lieut. F. A. Heyman	1906-1907

when the unit was converted into the 1st Bridging Train.

**B Troop, Bridging Battalion.*

Capt. G. A. Travers	1896-1899
„ H. Prentice	1899-1901
„ C. E. G. Vesey	1901-1905
Bt. Major C. B. Thomson	1905-1907
Capt. P. B. O'Connor	1907-1907

when the unit was converted into the 2nd Bridging Train.

* The titles of these troops were changed in May, 1905, to 1st and 2nd Bridging Companies.

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C Troop, Bridging Battalion.

Capt. G. A. Travers	1899-1902
Lieut. G. H. Addison	1902-1903
Capt. D. M. Griffith	1903-1905
„ E. S. Sandys	1905-1907

when the unit was converted into the 3rd Bridging Train.

D Troop, Bridging Battalion.

2nd Lieut. F. L. N. Giles	1900-1901
Lieut. F. R. S. Gervers	1901-1901
Capt. D. M. Griffith	1901-1902

when the troop was disbanded.

NAMES OF COMMANDING OFFICERS OF B (EQUIPMENT) TROOP.

Capt. R. N. Dawson (now General Dawson-Scott	1863-1866
„ M. J. Wheatley	1866-1868
„ M. Lambert	1868-1870
„ A. G. Durnford	1870-1872
„ R. N. Buckle	1872-1873
„ W. H. Patten	1874-1877

NAMES OF COMMANDING OFFICERS OF C (TELEGRAPH) TROOP.

C Troop, R.E. Train.

Capt. M. Lambert	1870-1872
Major A. G. Durnford	1872-1877
„ A. C. Hamilton (now Lord Belhaven and Stenton)	1877-1881
Major Sir A. W. Mackworth, Bart. ...	1881-1883
Capt. R. H. Jelf	1883-1884

1st Division Telegraph Battalion.

Capt. R. H. Jelf	1884-1884
Lieut. F. G. Bowles	1884-1885
Bt. Lieut.-Colonel R. H. Jelf	1886-1889
Major C. F. C. Beresford	1889-1892
„ R. L. Hippisley	1892-1898
„ W. F. Hawkins	1898-1899
„ H. B. H. Wright	1899-1900
„ H. B. H. Wright	1902-1903

3rd Division Telegraph Battalion.

Capt. S. H. Powell	1900-1901
„ G. B. Roberts	1901-1902
Major H. B. Williams	1902-1903
Bt. Major E. G. Godfrey-Faussett ...	1903-1903

* The title of this troop was changed in May, 1905, to 3rd Bridging Company.

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1st Telegraph Division, Field Force, South Africa.

Capt. E. G. Godfrey-Faussett 1899-1901
Major H. B. H. Wright 1901-1901

Subdivided into two Divisions, November, 1901.

1st Division, 1st Telegraph Division, Field Force, South Africa.

Bt. Major E. G. Godfrey-Faussett ... 1901-1902

2nd Division, 1st Telegraph Division, Field Force, South Africa.

Bt. Major J. S. Fowler 1901-1902

1st Division and Cadre 3rd Division.

Major H. B. H. Wright 1903-1905

2nd Division.

Bt. Major E. G. Godfrey-Faussett ... 1903-1905

1st Telegraph Company and Cadre 3rd Telegraph Company.

Major H. B. H. Wright 1905-1907

2nd Telegraph Company.

Bt. Major E. G. Godfrey-Faussett ... 1905-1906
Capt. A. B. R. Hildebrand 1906-1907

Note.—Lord Kitchener served as a subaltern in the original C Troop from April, 1873, to October, 1874.

NAMES OF COMMANDING OFFICERS OF FIELD TROOPS.

Mounted Detachment.

Lieut. A. E. Sandbach 1885

Capt. W. F. H. S. Kincaid 1888-1893
„ A. E. Sandbach 1893-1895
„ A. H. Cowie 1895-1899

1st Field Troop.

Lieut. C. O. C. Bowen... March 1899-October 1899
Major A. G. Hunter-Weston 1899-1900
Capt. C. O. C. Bowen 1900-1903
Lieut. E. N. Mozley 1903-1904
Capt. C. M. Carpenter... 1904-1907
„ C. C. de la P. Beresford ... 1907

2nd Field Troop (formed April, 1900).

Capt. F. R. F. Boileau... 1900-1900
„ F. K. Fair 1900-1902
„ A. H. W. Grubb... 1902-1902
„ R. S. Walker 1902-1903
Lieut. A. H. du Boulay 1903-1904
Capt. C. de W. Crookshank 1904-1907
Lieut. H. W. Herring 1907-1908
Capt. C. N. North 1908

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3rd Field Troop (formed August, 1900).

Lieut. R. G. Earle	1900-1906
Capt. S. H. Wilson	1906-1906
„ R. E. D. Goldingham	1906-1908
„ A. C. Baylay	1908

4th Field Troop (formed April, 1907).

Capt. E. S. Sandys	1907

5th Field Troop (formed April, 1907).

Capt. P. B. O'Connor	1907

NAMES OF OFFICERS IN CHARGE OF BALLOON ESTABLISHMENTS, ETC.

Major H. P. Lee	1882-1884
„ J. L. B. Templer (7th K.R. Rifles)	1882-1887
„ H. Elsdale	1884-1888
„ C. M. Watson	1888-1889
Lieut. B. R. Ward	1889-1890
„ H. B. Jones	1890-1891
Capt. G. M. Heath	1898
Lieut. Blakeney	1900-1901
„ Spaight	1900-1902
„ Smith	1902
Colonel J. E. Capper	1903

INSTRUCTORS IN BALLOONING.

Major J. L. B. Templer	1887-1897
Capt. W. A. de C. King	1906

SUPERINTENDENTS OF BALLOON FACTORY.

Lieut.-Colonel J. L. B. Templer ...	1897-1899
„ J. Macdonald	1899-1900 (Acting)
Major F. C. Trollope (Grenadier Guards)	1900-1901 „
Lieut.-Colonel J. L. B. Templer ...	1901-1906

COMMANDANT OF BALLOON SCHOOL AND SUPERINTENDENT OF BALLOON FACTORY.

Colonel J. E. Capper, C.B.	1906

ASSISTANT SUPERINTENDENT OF BALLOON FACTORY.

Capt. A. D. Carden	1907

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THE DEFENCE OF A POSITION WITH REFERENCE TO NIGHT OPERATIONS.

By Brevet Colonel A. W. Roper, R.E.

Though considerable importance is nowadays attached to the practising of night operations, attacks under cover of darkness are seldom undertaken against a properly entrenched and defended position. Moreover, in working out schemes of defence, it is customary to ignore the conditions which prevail at night. There is consequently a risk that certain precautions which should be taken may be overlooked, and that the difficulties of a night attack against a skilful enemy may be underrated.

In close intersected country, like many parts of the South of England, a night attack on a large scale would be so difficult an operation to carry through, that it would probably rarely be attempted. But in open country a night attack is a comparatively easy matter, for there are no obstacles such as hedges to break up the formation of the attacking force.

Consequently it is in open country that night attacks are most likely to be attempted, and the more open the country the more likely is it that any attack made will take place under cover of darkness.

When however one selects a defensive position in daylight, one naturally looks for open ground in front, with a view to reducing as far as possible the chance of the assailant obtaining cover during his advance. But in selecting such a position one not only reduces the likelihood of an attack being made in daylight, but at the same time one increases the probability that the enemy will have recourse to night operations.

Our textbook, *Combined Training*, discourages attempts to drive an enemy out of a very strong position. The losses that must necessarily be incurred in so doing will probably be so heavy that they should if possible be avoided. Consequently *Combined Training* lays down that a commander should seldom attack a strong position if by manœuvring he can compel his adversary to occupy a weaker one.

But it may be impossible to manœuvre the defender out of his position, and yet it may be essential to get possession of it. Under such circumstances it would seem that the assailant must have recourse to night operations.

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This happened several times in Manchuria. It will be sufficient however to quote two instances.

Early in July, 1904, the Russians were falling back on Kaiping, followed by the 2nd Japanese Army. On the 7th the Japanese ascertained that the Russians were holding a position some seven miles long and having a wide stretch of level ground in front. Fearing heavy loss from artillery fire if they attempted to traverse this open ground in daylight, the Japanese waited till it was dark. They then advanced, and finally made a successful attack at daybreak.

Again, in the advance on Liao-yang, the same Army found its way barred by the Russians at Shou-shan-pu. To facilitate the advance of the 4th Army on the right, it was essential that the Russians should be driven from this position. On the 30th August two attacks were made in daylight and both failed. The Japanese then realized that a position whose front and flanks bristled with obstacles under the close fire of musketry was practically impregnable to assault by day. They therefore decided to postpone the renewal of the attack till after dark.

From this it will be seen that a position which is very strong against an attack made in daylight, to some extent defeats its own object, because the enemy, if he attacks at all, will probably have recourse to night operations. The defenders therefore should consider what additional precautions are necessary to repel a night attack, even if it does not seem necessary to take up another position.

Combined Training devotes some 12 pages to the "Defence of a Position," but they treat the subject almost, if not entirely, from the point of view of resisting an attack by daylight. Similarly the instructions regarding night operations deal principally with the attack.

Let us first consider the question as regards defence against an attack in daylight.

Included in the list given by *Combined Training* of the chief requisites of a defensive position are the following :--

(*a*). "Clear field of fire over the country in front and on the flanks, and no dead or unseen ground within effective range."

(*b*). "Good artillery positions with a clear field of fire to the front and flanks."

Both of these refer to efficiency of fire, and they appear to be based on the following principle laid down in *Combined Training* :— "That all movements on the battlefield have but one object in view, viz., the attainment of superiority of fire." With this idea great stress is laid on the importance of a good field of fire.

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Combined Training makes the following statement regarding the attack of a position :—"Within 800 yards of a line of infantry, provided that they are steady enough to take careful aim, and there is a good field of fire, the ground over which the attack must pass is so closely swept by a sheet of lead as to be well-nigh impassable to troops in any other formation than lines of skirmishers, until the enemy's fire has been to some extent subdued."

It will be noticed that this statement contains three provisos. If any one of these is not complied with, the easier it is for the assailant. The three provisos are :—

(1). That the defenders are steady enough to take careful aim.
(2). That the field of fire is good.
(3). Until the enemy's fire has been to some extent subdued.

The result of failing to comply with the first of these provisos is well shown by an incident that occurred in the Russo-Japanese War. On the 11th October, 1904, during the Battle of the Sha-ho, General Okasaki with his brigade attacked a hill called Terayama. The Russian position offered admirable shooting conditions. In most directions there was an almost perfect field of fire up to a range of about 1,000 yards, and this glacis could also be enfiladed by the Russian artillery. In spite of these difficulties the Japanese got close up to the Russian position without suffering much loss. Actually they covered the last 600 yards in one rush. The explanation seems to be that the Russian artillery neglected the attacking infantry and fired on the Japanese artillery, whereas the latter shelled the Russian firing line, with the result that the Russians kept their heads down and did not take careful aim.

The second proviso refers to the field of fire, on the importance of which great stress is also laid in the requisites of a defensive position. The characteristics of a good field of fire are so well known that it is unnecessary to describe them. The kind of country that has these qualifications is however often ideal ground for a night attack, *e.g.*, the St. Privat end of the battlefield of Gravelotte, and also the Boer field of fire at Modder River.

The third proviso points out the difficulty of carrying through an attack before the enemy's fire has been to some extent subdued. This can be brought about by superiority of fire on the part of the assailant, but the better the position of the defenders, and the better they are entrenched, the more difficult it is to accomplish. It can however be also effected in another way, viz., by waiting till it is night. As soon as darkness comes over the scene the fire of the defenders must inevitably be to some extent subdued. In fact the requisites of a defensive position relating to efficiency of fire then become practically valueless.

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As soon as it gets dark men can no longer see the sights of their rifles, and the usual result is that they fire in the air. This was often the case in South Africa when there was a scare at the blockhouses along the railways. On such occasions it was not unusual for the telegraph wires to suffer more than the Boers.

Moreover, when it is dark, the enemy will probably be invisible at anything over 400 yards. The most perfect field of fire is thus not only robbed of much of its value, but it becomes positively disadvantageous, as it presents no obstacles to an enemy's advance such as would be provided by, for instance, the hedges in a close intersected country. Consequently to repel a night attack the defenders must be able to destroy the assailants during the last 400 yards or so of their advance, whereas in dealing with an attack in daylight, the defenders should be able to inflict loss on their adversaries while they traverse the field of fire for perhaps a mile or more.

During the Russo-Japanese War many night attacks were made, but as a general rule there was seldom a night march of any length preceding the actual attack. There were therefore no operations similar to those undertaken by our troops at Tel-el-Kebir, Stormberg, and Magersfontein, which involved night marches of several miles. In fact the opposing forces were so close together that there can seldom have been regular outposts between them. Any there were must have been so close to the main body that the latter can have received only very short notice when an attack was made at night, and this must have considerably facilitated the task of the assailant.

Another characteristic of Japanese night operations was the careful manner in which the enemy's position was reconnoitred. During daylight, if the two forces were not in close touch with each other, the position—as far as could be seen from a distance—was examined and its strength ascertained. After dark scouts, under officers, were sent forward to get as close as they could to the enemy's line, to ascertain the nature of the defences and also the best way of avoiding or passing any obstacles. The Japanese attached very great importance to obstacles in night operations, and frequently sent forward sappers with the scouts to cut leads, etc.

The Japanese also used night operations as a means of approaching close to the defenders' position without suffering much loss. They used to push forward a few hundred yards and entrench themselves. After a short time they would advance another few hundred yards. If luck favoured them, they would by such means be entrenched close to the defenders by daybreak.

The defenders must therefore be prepared in the first instance for a careful reconnaissance by the assailant, who will endeavour not only to locate the position of trenches and obstacles, but also to destroy the latter.

If the two forces are not in close touch with each other, the

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assailant will probably reconnoitre first in daylight. To prevent his getting much information in this way, it may often be desirable to shift the firing line from the position that gives the best field of fire. The Japanese sometimes did this when they expected a night attack, as for instance during the Battle of the Sha-ho. Their idea was that against a night attack a field of fire of about 400 yards was sufficient, and that by siting the trenches in this way the distant reconnaissance was rendered more difficult.

In undulating country it may be desirable to place the firing line in a valley, so that the assailant may show up against the skyline as he advances.

Again the assailant will probably make a close reconnaissance under cover of darkness, and this must be made as difficult and dangerous for him as possible. The defender therefore should not only make use of patrolling and small ambushes, but also of various contrivances which will give an alarm, *e.g.*, spring guns, land mines, flares, etc. Search lights if available might also prove useful.

Next the assailant may endeavour to push forward under cover of darkness and entrench himself within close range of the defender. The precautions suggested against the close reconnaissance are useful against this form of advance, but something more is needed. It would seem that small counter-attacks should therefore be employed. No doubt it is rather difficult to manage a counter-attack in the dark, but the defenders should at least have the advantage of knowing the ground better than the enemy does.

Finally, the latter may try to rush and overwhelm the outposts or even the main position. To prevent this it is essential that the defender should be able to overwhelm and destroy the attacking troops during the last few hundred yards of their advance.

It is therefore necessary to delay the attacking troops, and this is done by using obstacles. But these are of little use unless they are under the close fire of the defenders. If this has not been provided for, the enemy will be able to cut his way through them without suffering much loss. This condition is rather hard to satisfy at night.

Some means of illuminating the sights of the rifles are required, but, so far as I know, no satisfactory method of doing so has been discovered. Luminous paint does not seem to be much use. You also want means of lighting up the attacking force; and here search lights when available are very useful. But failing search lights—or to supplement them—flares should be arranged to be fired electrically or mechanically. Sometimes star shell may be available and will be useful, as in the Siege of Port Arthur.

Rests are required to prevent men firing in the air. Those employed at the blockhouses in South Africa, to direct fire along the fences, were too elaborate to be hastily constructed, and the amount of transport that would be needed to constantly move them, would be

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prohibitive. Consequently such rests would not usually be available in an ordinary campaign.

But various expedients may be used which are a great deal better than nothing, *e.g.*, a groove cut in the parapet will answer the purpose, if carefully made in daylight, or a string stretched along the parapet would keep the muzzles down. A point to be remembered is that machine guns are comparatively easy to lay at night, and that they are consequently particularly useful against a night attack.

In the case, then, of a force which is not liable to be attacked in daylight, it would appear reasonable not to bother about a field of fire of more than about 400 yards. But on the other hand it is then of the utmost importance to strengthen as far as possible, obstacles within a few hundred yards of the position, and also to provide rifle rests and various alarms such as flares, spring guns, etc., and also land mines.

If the force is liable to be attacked both by day and by night, it would seem that two positions should be entrenched, and that for choice the position to be occupied by night should be in advance of that to be occupied by day.

The failure of some of the Japanese night attacks during the recent war was usually due to superiority of fire on the part of the Russians. But this superiority was brought about in various ways. It is often stated to have been the fire of machine guns that decided the struggle ; but probably a still more frequent source of disaster was the delaying action of obstacles under fire, especially when the assailants were shown up by search lights.

The South African War provided many examples of night attacks. When these were successful, it will usually be found that there were no obstacles, or very few, and as a rule the outpost arrangements were bad.

I venture to think that on manœuvres the necessity for obstacles round a camp is often overlooked. On active service the omission of these precautionary measures may mean disaster, and they should be insisted on in peace operations. The R.E. should also be trained in cutting through obstacles in the dark.

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STUDIES ON THE USE OF FIELD TELEGRAPHS IN SOUTH AFRICA.

By MAJOR E. G. GODFREY-FAUSSETT, R.E.

IV.—WIDELY DISPERSED COLUMNS CONCENTRATING STRATEGICALLY ON AN OBJECTIVE (THE ADVANCE ON PRETORIA).

BY the end of April, 1900, three more sections had arrived from England, under Capt. Wright. The relief of Ladysmith also liberated the section which had taken part in the defence,* so that for the combined forward movement of the whole army on the Transvaal eight sections were available.

It will be convenient to extend the lettering system which was used at Bloemfontein to the whole eight sections. There were then :—

A. Lieut. Hildebrand (freed by the relief of Ladysmith).
B. Lieut. Turner (the section which took part in the relief of Ladysmith under Lieut. Jelf).
C. Lieut. Mackworth (formed at Bloemfontein, of four cable detachments only).
D. Lieut. Moir (two air-line detachments).
E. Lieut. Henrici (two air-line detachments).
F. Lieut. Webber (two air-line detachments).
G. Lieut. Macfie.
H. Lieut. Sherrard.

For the forward movement the troops under Lord Roberts' supreme command were divided into five columns :—

(1). The Natal Army, under Sir Redvers Buller, the II., IV., and V. Divisions, with A and B Telegraph Sections.
(2). General Ian Hamilton's column, M.I. and IX. Division, with D and E Telegraph Sections.
(3). The central force, under Lord Roberts, Cavalry Division, VII. and XI. Divisions, with C and F Sections.
(4). Lord Methuen's force, I. Division, with H Section.
(5). General Hunter's force, X. Division, with G Section.

* A description of the valuable work done by the section in Ladysmith, by one of the officers who was present, would be most interesting.

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In addition to these columns, the III. Division (Chermside), VI. Division (Kelly Kenny), and VIII. Division (Rundle) were employed in the Orange River Colony, and were kept in touch chiefly on repaired permanent lines by telegraph troops at the disposal of Capt. Fowler, who was in charge of the O.R.C. communications.

The whole of this strategic movement on a front of some 350 miles was controlled by the Commander-in-Chief by means of the telegraphs, which kept each column in communication with its base.

(1). THE NATAL ARMY.

On May 7th the II. Division quitted its camp at Ladysmith and marched to Helpmakaar. It was accompanied by air line run by Hildebrand to that place, where the permanent line was met, and communication opened by it with Pietermaritzburg.

The Helpmakaar position was successfully attacked on the 13th, and the march was resumed to Dundee, the permanent line being repaired and utilized. On the 19th the front of the Boer position at Laing's Nek was reached.

The V. Division followed direct from Ladysmith to Glencoe, following the railway, and the railway telegraphs were put in order.

On June 8th the leading divisions struck off to the left into the Orange River Colony, seizing Botha's Pass. The Battle of Alleman's Nek completely turned the Boer position, and Volksrust was entered on the 12th. This flank movement was followed by air line, and the railway telegraph line to Volksrust was repaired.

The advance along the railway was resumed on the 20th, Standerton was occupied on the 23rd, and hands were joined with Lord Roberts' columns at Vlakfontein on 4th July.

(2). IAN HAMILTON'S FORCE.

General Ian Hamilton left Thabanchu on April 30th with the M.I. Division, supported by the IX. Division, and accompanied by air line run by D and E Sections, under Moir. Winburg (62 miles) was reached on the 5th May, and cross communication with Lord Roberts was opened by the Winburg-Smaldeel permanent line. Moir rejoined the main body with D Section, and Henrici was reinforced by a cable detachment.

On the 11th the line was continued to Twistniet, and a fresh cross line was laid by Mackworth. The section rejoined the main body at Kroonstad on the 13th May.

(3). LORD ROBERTS' FORCE.

This force left Karee Siding on the 3rd May, and followed the railway to Kroonstad. The railway telegraphs were repaired by F Section, three wires being repaired simultaneously. On 13th May

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a bivouac at Jordaans Siding held four sections together, for the first time since 16th November, 1899.

The advance was resumed on 22nd May, the railway telegraph line being repaired as before. During this advance a cable cart always went in advance, putting one railway wire through, and coming in on it whenever required during the day, so that Lord Roberts was in constant communication with the rear. The cart carried a telegraph distinguishing flag and was allowed precedence at all drifts.

The Vaal River was crossed on the 27th May, and Johannesberg occupied on the 30th. Henrici's section was left here in charge of the large office and telephone exchange.

During the advance to Pretoria the direct telegraph line over the veldt was repaired. Pretoria was reached on 5th June.

(4). LORD METHUEN'S FORCE.

Lord Methuen's force left Kimberley for Hoopstad on the 14th May, accompanied by H Section, under MacInnes and Sherrard, running cable with headquarters, and replacing it with air line. The air line reached Hoopstad on the 18th (68 miles).

On arrival at Bothaville (29th May) the column was diverted to Kroonstad by Lord Roberts, as the enemy was reported to be threatening that town. The permanent line from Bothaville to Kroonstad was repaired and used. Kroonstad was reached on 28th May.

(5). GENERAL HUNTER'S FORCE.

The X. Division moved north on the 3rd May, G Section, under Macfie, repairing the railway telegraph line as it advanced. Vryburg was reached on the 23rd, and, after the relief of Mafeking, the force left the railway line at Maribogo on the 29th. Connection with the permanent line at Baber's Pan was obtained by air line and cable, and this was repaired to Lichtenburg (June 3rd). From here connection was opened with Mafeking by the permanent line.

By the 8th June a branch partly of air line partly of bare wire laid on the ground had been carried on from Lichtenburg to Ventersdorp, through which place communication with Johannesberg and Pretoria was effected by the permanent lines on the 13th June. This line was the only outlet from Pretoria for some days, during De Wet's raids on the main line at Roodeval.

The five columns as they advanced were kept in good communication. Eight infantry divisions were engaged, or about the equivalent of the six large divisions of the present field army. According to

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present organization, 12 air-line detachments and 18 cable detachments would have been available—actually about 12 air-line and 8 cable detachments were employed. The extra cable detachments would have allowed of more constant communication with the various bodies of troops detached from the columns.

No attempt could be made to keep the cavalry division in touch when it made a turning movement to the west of Johannesberg. A wireless company would have been most valuable.

The Wheatstone automatic was used with great success with Lord Roberts' column. While the column was on the move Bloemfontein—the base office—punched up the messages as they came in from the rear, and as soon as the headquarter office bivouacked these were sent through, leaving the line clear for the work from the front. At headquarters the large mass of received work was written up during the night, and the messages were delivered early in the morning. This night work was very heavy on the headquarter operators, but arrangements were made to carry them in wagons during the marches, when they got some sleep. It was found necessary to tell off three wagons for the headquarter office alone, which marched and bivouacked together under a senior N.C.O., independent of the section organization. A small marquee captured at Bloemfontein was carried for this office.

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CAPTAIN SIR JOSIAS BODLEY.

DIRECTOR-GENERAL OF FORTIFICATIONS IN IRELAND, 1612—1617.

By LIEUT. W. P. PAKENHAM-WALSH, R.E., R.S.A.I.

JOSIAS BODLEY was born about 1550, probably at Exeter, being the fifth and youngest son of John Bodley of that city, by Joan, daughter and co-heiress of Robert Hone of Ottery St. Mary.

Of his brothers, the eldest was Sir Thomas Bodley the distinguished diplomatist, who founded the Library at Oxford which is named after him. The second and fourth brothers, John and Zachary, were clergymen, but where they lived is unknown; while the third, Lawrence, D.D., was a Canon of Exeter.

In the reign of Mary his parents were compelled, on account of strong Protestant tendencies, to seek refuge in Germany and afterwards at Geneva, where, with his brothers, Josias is said to have studied Hebrew under Chevallier, Greek under Beroald, and Divinity under Calvin and Beza, while in after years we find him and his brothers corresponding with Drusius.*

On the accession of Elizabeth the Bodleys returned to London, where they settled, and in 1562 the father, John Bodley, obtained a license for seven years from the Queen for the exclusive printing of the Geneva Bible.

Josias was further educated at Merton College, Oxford,† of which his brother Thomas was at that time a Fellow; but he appears never to have graduated, and to have adopted the profession of arms instead. He served for some time in the Low Countries, then beginning to earn their reputation as the cock-pit of Europe, and he also seems to have visited Poland, from some casual references to Polish drinking customs in his *Journey into Lecale.*

Tyrone's Rebellion having broken out in Ireland, it was decided to reinforce the troops there by a regiment of 1,050 men, drawn from the forces in the Netherlands, of which Sir Samuel Bagnell was Colonel, and Edward Blayney, Josias Bodley, Jephson, Sidney and Toby Caulfeild‡ were Captains.§ They were first stationed at

* The above is according to the *Dictionary of National Biography;* but some other authorities say he was not born till the return of the family to London, about 1560.

† *Ath. Oxon.*, Vol. I., p. 328.

‡ Afterwards Lord Caulfeild, Master-General of the Ordnance.

§ Fyne's *Moryson's Itinery* (1617), Part II.

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Newry, where Bodley formed a very poor opinion of the food, and while there he was mentioned for good service in the action under the Lord Deputy against O'Neill, October 2nd, 1600, and again at Drogheda, March 31st, 1601.*

At this time also he first showed his ability as a military engineer in an attack on a village called Loghrorcan, which is on a small island five miles from Armagh, of which the following is an almost contemporary account† :—

"The sixth of April, 1601, his Lordship receiued aduertisment from Captaine Iosias Bodley, at the Newry, that he and Captaine Edward Blany, Gouernour of the Forte of Mount-Norreys, purposing to surprise Loghrorcan, could not carrie a boat, which they had prouided to that purpose, but he, carrying certain fireworks prouided in case the boat should faile, went to the Fort, and joyning with Captaine Blany, marched towards that Iland, where they arriued by eight of the clocke in the morning, and leauing their forces behind a Wood, they both went together to discouer the Iland: which done Captaine Bodley made readye thirtie arrowes with wildfier, and so they both fell downe with one hundred shot close to the water, where the shot playing incessently upon the Iland, while the other deliuered their arrowes, suddenly the howses fired, and burnt so vehemently, as the rebels lodging there, forsooke the Iland, and swumme to the further shoare. That after they saw all burnt to the ground, they fired a great house upon their side of the shoare, and killed there sixe kerne (gaining their arms) besides Churles and Calliachs, and after the burning of other houses also, they brought away some Cowes and Sheepe, with other pillage: and they understood by a prisoner, that there were about thirty persons in the Iland, whereof onely eight swumme away (of which foure were shot in the water), so as the rest either were killed or lay hurt in the Iland. Likewise they understood by the said prisoner greate store of butter, corne, meale, and powder, was burnt and spoiled in the Iland, which all the rebels in that Countrey made their magasine. Further, that some forty kerne skirmished with them at places of aduantage, in their retreat for two miles march: but howsoeuer the common opinion was, that the Rebels sustained great losse be this seruice, yet of the English onely two were slaine and seuen hurt."

Meanwhile the campaign against the rebels was being pushed forward in the South of Ireland by Sir George Carew, "Lieutenant-Generall of the Artillery" and Lord President of Munster, afterwards Earl of Totnes, and Master-General of the Ordnance in Ireland.

These operations bear a curious resemblance in many ways to the later stages of the South African War. The country was wild and

* Calendar of State Papers, Ireland, 1600–1.
† Fyne's *Moryson's Itinery* (1617), Part II., pp. 97, 98.

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practically unknown to the troops, who were opposed by brave but undisciplined rebels. They were however, unlike the Boers, badly armed, but were assisted by regular troops from Spain, then the first military power in Europe, and as will be seen later had several skilled engineers, mostly Jesuits. The methods adopted were also South African, this being the first really organized use by the British Army of mounted infantry, while the strategical policy was to seize, fortify, and hold lines of castles, thus dividing the country like the blockhouse lines in South Africa into areas which were then cleared by sweeping drives.

A very full account of these operations is given by a contemporary writer in a book* written for the glorification of Sir George Carew, and although Bodley took no part in the earlier operations, the accounts of some of the siege operations are so interesting from a Sapper point of view that they are inserted here.

On the 25th May, 1600, Sir George Carew laid siege to Limerick, and "that night . . . the Armie incamped within little more than a mile thereof. The three dayes next following, wee bestowed in providing things necessary for the mounting and drawing of the Cannon, the Citie being altogether destitute of necessaries thereunto, which at last with many difficulties was effected: Wherein the President shewed himselfe to bee a Master in that facultie; for Canonier or other Artificer (skilfull in the mountures of Ordnance) he had none, the Smiths and Carpenters were onely directed by him, according to the proportion he gave, they wrought, and in the end a demie Cannon was mounted, and drawen towards the gate of the Cittie, that leadeth to the Iland of Loghguire."

After taking Limerick he proceeded to besiege the neighbouring castle of the Glin, the seat of the Knight of Glin, a member of the family of the Earl of Desmond, who were leaders of the rebellion, and on the 8th July—"when wee looked that the cannon should begin to play the Cannonniere found the Peece to be cloyed, all the art and skill which either the smith or himselfe could or did use, prevailed nothing. The President, (who is a man that knowes well to manage great Artillery) commanded that the peece upon her caryage (as she was) should be abased at the tayle, and eleuated at the musle, as high as it might bee: then he willed the Gunner to giue her a full charge of powder, roule a shott after it, and to giue fire at the mouth, whereby the touch hole was presently cleared, to the great rejoycing of the Armie, which of necessitie in attempting the Castle (without the favour of the Cannon) must haue endured great losse. This particular I thought good not to omitt, because it may bee an Instruction to others, whensoever the like accident should happen."

* *Pacata Hibernia*, by Thomas Stafford, 1633. This book is in the Corps Library, and well worthy of study.

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While this siege was in progress the rebels besieged the Royal garrison in Liscaghan Castle on the 16th July, and "placed an Engine (well knowen in this Countrie) called a Sow (to the Wals thereof) to sapp the same: But the Defendants did so well acquit themselves in a Sally, as they tare the Sow in peeces, made her to cast her Pigs, and slew twentie seuen of them dead in the place."

On the 30th August Sir Charles Willmott took Ardart, where the rebels had stood a siege "for some nine dayes, made good defence, and had burned with Fireworkes such Boardes and Timber as Sir Charles had placed against the wall of the Castle for his men's safetie as they undermined."

The same Sir Charles proceeded in November to besiege Listoell (Listowel) Castle, the last stronghold remaining to Fitzmaurice, Lord of Lixnaw, and "he sate downe before it upon the fifth of November, attempting to get it by a Myne, in the which after he had wrought fiue or sixe dayes, and brought it underneath the Castle wall, being ready to make a bed for the placing of the powder, suddainly the spring brake foorth in such abundance, as that worke became fruitlesse; thereupon new ground was sought, which proved good, the foundation of the Castle was undermined, as farre as the middest of the Seller, which the Ward perceiving, made humble suit to bee permitted to depart with their lines, which Sir Charles absolutely refused: but if they would simply render themselues, the Castle and all things in it to his discretion, hee would then stay further proceeding in his worke, otherwise they might looke within very few howers to bee blowen up."

The expected Spanish invasion was now becoming imminent, and the Lord President asked the Council in England, on the 13th January, 1600–1, to send the following stores:—

"Victuals for 3,250 men,
"5 lasts of powder with match and lead,
"2,000 shovels and spades,
"500 pickaxes and 50 crowes of iron,"

and again on the 6th August, 1601, he reported as follows regarding the defences of Cork*:—"The rasing of Shandon is to no purpose, for every hill and ditch (neere the towne) commands the Citie no lesse then it, the defences of earth (which by my directions are in making) are onely made to winne time; and I have so provided, that the charge of the workemen is borne by the Towne and Countrey, the Queene's expences is no more, but the use of her Shovels, Spades, Pickaxes and Whildebarrowes, etc."

In the early autumn of the same year the Spanish force, under Don Juan de Aguila, landed at Kinsale, and on the 17th October the

* *Pacata Hibernia*, p. 181.

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English Army, under Lord Deputy Mountjoy, with whom were the Lord President and the Earl of Clanricarde, proceeded to besiege the town. The "Sergeant Major General"* of this force was Sir John Barkley, while Capt. Josias Bodley came from Newry as Trench-master and Chief Engineer. The following extracts regarding the siege are taken from *Pacata Hibernia*:—

27th October.—"Wee attended all that day for the landing of the Artillery, and perfected the intrenchment about the Armie, which was left unperfected the day before through the extreame fowlnesse of the weather; and at night Sir John Barkley, Sir William Godolphin and Captaine Bodley were sent to view the most commodious place to plant the Artillery for the battering of the Castle of Rincorran which was situated upon the River of Kinsale, something more then a quarter of a mile from the Towne. . . . October 31st.—The Lord President, misliking the manner of the making of the battery, not being constantly made upon one place, but upon the Spikes of the Castle, requested the Lord Deputie to leaue that service to his care whereunto he easily assented. To show that hee was well experienced in the profession of a Cannonier, wherein hee had beene, (by reason of his imployments) long practised, hee performed the office of a Master-Gunner, making some shot, and that the Artillery might play as well by night as day, himselfe did take and score out his ground-markes, and with his Quadrant tooke the true levell, so as the want of daylight was no hindrance, but in doing thereof hee fairely escaped two Musket-shott: for as hee was standing at the Breech of a Cannon, busie about his worke, the one lighted upon the muzzle of the Peece, the other upon the Carriage close to the Trunnions. . . . November 17th.—Out of an extraordinary desire to effect somewhat, the seventeenth being the most happy day of her Majestie's Coronation, which wee meant to haue solemnized with some extraordinary Adventure, if the weather would haue suffered us to looke abroad: wee sent at night when the storme was somewhat appeased, the Sergeant Major, and Captaine Bodley, with some foure hundred Foot to discover the ground of Castle Ny Parke, and to see whether it might be carried with the Pickaxe, which was accordingly attempted; but the Engine wee had gotten to defend our men while they were at worke,† being not so strong as it should haue beene, they within the Castle hauing store of very great stones on the top, tumbled them downe so fast as brake it, so as they returned with the losse of two men, and proceeded no further in that course. . . . November 20th.—The same day a Platforme was made upon a ground of advantage (not farre from the Campe) that commanded one part of

* This officer, whose title is the origin of "Major-General," would now be called the Adjutant-General.

† Presumably a sap shield.

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the Towne, that under the favour thereof wee might the better make our neerer Approaches, which at that time wee could hardly haue done, by reason of the great extreame frost, and a Demy-Cannon mounted vpon it. . . . November 23rd.—The Lord Deputie this night began to make his approaches neerer the towne and for that purpose caused some 1,000 Foot to be drawne out by Sir John Barkley, Sir Benjamin Berry and Captaine Bodley who continued the worke all night, and although the ground were extreame hard (by reason of the frost) and the night very light, yet they brought the worke to very good perfection, the enemy played all the night upon them with great Volleyes but hurt but three men, neither in the Trenches, nor in divers Sallies they made, in the one whereof a Squadron of our new men beat them backe to the gates. . . . November 25th.—This night direction was giuen to haue a Plat-forme made for the Artillery upon the trench which was made on Munday night. . . . December 1st.—This night the Marshall, Sir John Barkley, Captaine Blaynie and Captaine Bodley (the Lord Deputie leaving the President in the Campe being almost all night present) drew out fiue and twentie of every Company, and intrenched themselues on a Hill, on the West side of the Towne, within lesse than halfe Callivers shot of the same, and cast up a small fort to lodge some Foote to serue as seconds for the Artillery (that was to be planted) not farre from it, our men being at worke, the Spaniards about midnight began to play upon them from the wals, and from a trench they possessed close to the West gate, and so continued very hotly till the morning: our men (that guarded the Pioners) playing likewise upon them, and divers hurt and killed on either side. Our men continued still in that worke, and brought the same before night to very good perfection, though the Spanyards (from their high Castles and other places of the Towne) sought to annoy them what they could."

A force of 6,000 rebels, with a regiment of Spaniards, under Tyrone and O'Donnell, attempted to raise the siege, but were heavily repulsed on the 24th December, and Kinsale surrendered on the 9th January, 1601–2, the Spaniards being paroled and sent back to Spain, and the good feeling between the erstwhile foes is shown by the following extract from a letter from the Lord President of Munster to Don Juan de Aguila, "late Commander of the Spanish Forces in Ireland," who had sent him a present of oranges and wine :—

CORKE, *17th September*, 1602.

I haue received profit by the booke of fortification which your Lordship left mee at your departure and hold it as a Relique in memory of yow, and as a good Schollar I haue put some things in practise whereof your Lordship at your returne hither againe (which I hope in God will be never) may be a witnesse whether I haue committed any error in the art or no.

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To commemorate their victory the Royal troops subscribed a sum, variously stated as £700 and £1,800, which they devoted towards establishing a library at Trinity College, Dublin, which had been founded by Queen Elizabeth nine years before. It seems evident that the Chief Engineer, Josias Bodley, was consulted as to the form the memorial should take, and that he suggested a library, being fired by the example of his brother Thomas, who had founded the Bodleian Library at Oxford in 1598, to which he (Josias) had presented in 1601 a fine quadrant and a large armillary sphere supported by three lions, which are still there. The present buildings of the Dublin Library were designed and erected between 1712 and 1722 by another Chief Engineer of Ireland, Thomas Burgh.*

An interesting event at this time was the erection of Haulbowline Fort in Cork Harbour, and the following extracts are from the same book:—14th January, 1601-2.—"About this time the Lord Deputie and the Lord President went by Boate to an Iland in the River of Corke, called Halbolin, sixe or seven miles from the Citie, which upon view they thought fit to bee fortified, being so seated, as that no shipping of any burthen can passe the same, but under the command thereof: Whereupon direction was given to Paul Ive (an Ingeneere) to raise a Fortification there and also another at Castle Ny Parke to command the Haven at Kinsale. Furthermore it was resolved in Councell, that Forts should haue been erected at Baltimore, and Beere-haven, as also Cittadells at Corke, Limerick and Waterford, to keepe the Citizens in some awe; but none of these workes were performed; saue onely the Forts at Halbowlyn and Castle Ny Parke aforesayd." On the 15th February the "Lord Deputie and Councell" wrote from Cork to the Lords in England that "Her Majestie must therefore be pleased to bee at some charge to erect Fortifications at Beere-haven, Kinsale and this place, the Commodities and weaknesse of these places being as well knowen to the Spaniards as to us, and further withall to erect Cittadels at Limerick, Corke and Waterford though it bee onely to assure the Townes from revolt."

As stated above, the forts at Haulbowline and Castle Park only were erected, and illustrations of these are given in the *Pacata Hibernia*. From these illustrations it would seem that these forts must have been among the earliest erected in the British Isles on the bastion trace,† which had been introduced on the Continent 60 years before. On the 18th July, 1602, however, the Lord President of Munster was authorized by the Privy Council to commence fortifications at Baltimore, but in the time of Bodley's successor, Pynnar, the

* See the *R.E. Journal* for August, 1907.

† The earliest known bastions now in existence are those of Verona, erected in 1523, though some early Italian writers say they were used 100 years previously. The bastions at Antwerp were erected in 1545.—*Encyclopædia Britannica.*

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question of funds for finishing these works became a constant source of trouble.

After the Siege of Kinsale, Bodley went north again, being appointed Governor of Armagh, while the army, under the Lord President, marched into Kerry, and besieged the Castle of Dunboy (Berehaven), which had been fortified by the rebels under the direction of several Jesuits and others, from whose letters the following extracts are taken :—

"A letter from James Archer, Jesuite, to Dominick Collins, Jesuite, Donboy, Thursday, 10th June, 1602. . . . Now to come to more particular matters, understand that there are but two wayes to attempt yow, that is, scaling with ladders, or Battery : for scaling I doubt not but your owne wits needs no direction ; and for Battery yow may make up the breach by night. The higher yow rayse your workes every way the better, but let it bee thicke and substantiall, raise of a greater height that worke Captaine Tirrell made betwixt the house and the cornell : make plaine the broken house on the South side. . . ."

"A letter from John Anias (who conceived himselfe to be a good Ingeniere) to Dominick Collins, Jesuite, at Donboy. Be carefull of your fortifying continually, with a most speciall care rayse in height the West side of your Port, fill your chambers on the South and North side with Hides, and earth ; what battery is made suddenly repayre it like valiant souldiers ; make plaine in the South side the remnant of the broken houses ; make wayes out of the Hall to scower and cast stones upon the Port, and if the Enemy would attempt the like, dig deepe the place wee first begun, and a trench aboue to defend the same, as I haue sayd unto yow. Although wee expect speedie reliefe out of Spaine, yet bee yow wise to preserue the store of Victualls discreetly ; Devise yourselves all the Invention possible to hold out this siege, which is the greatest honour in this kingdome ; with the next I shall prepare shooes for yow, send mee the cord or long line, and the rest of the Saltpeter, with all the yron borriers, seven peeces in all. Salute in my name Richard Mag Eoghegane* praying God to haue of his speciall Grace that careof your successe. From the Campe the —— of June, 1602. Your loving Cousin, John Anias. To Father Dominick, Beerehaven, these."

This John Anias had previously been taken prisoner in 1600 in connection with the rebellion of Florence MacCarthy, who had employed him to raise fortifications at Dunkerran. He was subsequently taken prisoner in October, 1602, by John Berry, Constable of Castle Mange, and was executed by martial law in the next month. "Whether he was a Priest or no, it was held doubtfull."

The latter part of May and the beginning of June, 1602, were

* Rebel Governor of Dunboy.

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occupied with this siege, which terminated in the fall of the Castle on June 17th, and it was afterwards blown up. The following are extracts from the account of the siege :—

"The Earle* being gone with his Armie marched as farre as the Abbey of Bantrie, about threescore miles from Corke, and there had notice that Donnell O'Sulivan Beare and his people, by the advice of two Spanyards, an Italian, and a Fryer called Dominicke Collins, did still continue their workes about the Castle of Dunboy; the Barbican whereof being a stone wall of sixteene foot in height, they faced with soddes intermingled with wood and faggots (aboue foure and twenty foot thick) for a defence against the Cannon. They had also sunke a low Plat-forme to plant their Ordnance for a counter-battery, and left nothing undone, either within or without the Castle, that in their opinions was meet for defence: But when it came to tryall, it appeared that their judgements fayled (as after yow shall heare), for the Barbican was not aboue sixe or eight foot distant from the Castle, the height whereof was exceeding high, not remembring that the ruines thereof would quickly fill the voyd space betweene them, and make a faire assault when a breach was made, whereby all their earth and sodd workes prooved vaine and fruitlesse, not so much as one Cannon shott being bestowed upon them, but as neere as the Cannoniers could take their aymes aboue it, as the President had directed." The following reasons were urged to the Lord President for not attacking the Castle; that "hee should find no landing place for his Ordnance neere unto it, and being landed, the wit of man was not able (without an infinite number of Pioners) to draw them unto the Castle; for all the grounds neere unto it, were either bog or rocks, and also that there was no convenience of ground to incamp in, no good water neere, nor wood for necessary use, or gabion stuffe within three miles of it." The Lord President replied "that bogs nor rocks should forbid the draught of the Cannon, the one hee would make passable by Faggots and Timber, the other hee would breake and smooth with pyoners' tooles."

On June 8th, 1602, Stafford writes :—"Wee also sent souldiers to the Wood to cut Gabion-stuffe, and to bring the rafters of an old Church to make joyces for the platforme to plant the Ordnance on. . . . June 11th the same night wee began our approaches; the care whereof the President imposed upon Captaine Francis Slingsby, a discreete and dexterous Gentleman, making him Trench-master, who performed with commendations the charge which was layed upon him; having all the day before employed a great partie of men to the Wood (which was a long mile and halfe distant from the Campe) to fetch more wattle to make gabions. The fourteenth and fifteenth, our men were busie making of gabions and drawing the

* The Earl of Thomond, the loyal head of the O'Briens.

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trenches neerer the Castle, Captaine Francis Slingsby being (as aforesaid) Trenchmaster. . . . The sixteenth the Gabions, Trenches and Platformes were finished and in the night the Demy-Cannon, and the two Culverins were drawen downe, and planted against the castle within 140 yards. . . . 17th June.—The Lord President's colours and the rest did clime up, and placed their Ensignes upon a turret of the barbicon, reinforced with earth and faggots of great thicknesse, unto which was added a large spurre on the South West part of the Castle of the height of sixteene foote as in like manner all the Turrets and Curtains of the Barbicon were reinforced, at the top whereof they barricadoed themselves with barrels of earth, and at the first approach there was within it, some of the Enemy with a Faulcon of Iron, whom our men forced to quit the place, and to retreat themselves into a Turret adjoyning upon the South side which was rampiered with earth some sixteene foote high. . . . They resolved to bestow the Powder which was recovered in the Castle to blow up the same, committed to the charge of Captaine Slingsbie. The two and twentyeth the Castle of Dunboy was accordingly blowne up with Powder, the out-Workes and Fortifications utterly destroyed."

To return to Bodley, who, as has been already stated, was now Governor of Armagh. The next we hear of him is that he intended to spend Christmas, 1602, in Lecale (Downpatrick), with his friends, Capts. Jephson and Toby Caulfeild, at the house of the Governor there, Sir Richard Morrison; but they were ordered by the "Sergeant Major," Sir Arthur Chichester, to fight Tyrone in Glenconkein, in Derry and Tyrone.

Having successfully concluded this "week-end war," they set out for Lecale, although it was eight days after Christmas, and of their adventures there is a most amusing account in Latin* by Bodley himself.

At midsummer, 1603, Bodley was in Waterford with Sir Richard Morrison, who was Governor there, and on the 21st March, 1604, he received the honour of knighthood from the Lord Deputy† at Reban, co. Kildare. On the 28th May of the same year he was appointed Governor of Duncannon Castle,‡ a post which he resigned in June, 1606, while in 1605 he was engaged on the fortifications in Munster, by which he further increased his reputation as an Engineer. He was in England in 1607, and returned with the appointment, granted him by the Privy Council, of "Superintendent of Castles," which however he held on the Establishment of the Army, and not

* Additional MSS. No. 4784, British Museum.

† In the Middle Ages the Viceroy of Ireland was a figurehead, usually a Royalty, who seldom was resident. The true Governor was the "Lord Deputy," or, more familiarly, the "Lord Lieutenant-General."

‡ Privy Seal Order, 5th January, 1604–5.

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by Patent. His stipend was 20s. Irish per diem, and he states that in that and the following year he rode over 700 miles on duty.

At this time the office of Surveyor-General was held by Sir William Parsons, afterwards Chief Secretary for Ireland, but on his fall from power in 1644 the office was joined with that of the Director-General of Fortifications. Bodley, however, assisted Parsons in 1609 with the survey of the Ulster Plantation, which he performed so well that we find a letter from the King to Chichester, now Lord Deputy, dated March 25th, 1615,* of which the following is an abstract:— "Acknowledges the care and industry of Sir Jos. Bodley and his men in the accurate and orderly survey they have lately made of the Ulster Plantation by his (the King's) command . . . And that no man may pretend ignorance of what is expected of him, Sir Jos. Bodley is to take a review of his last survey and shall signify to the Londoners, and to every undertaker, servitor and native their several defects and omissions that they may be all reformed or performed against next survey, which he (the King) has appointed to be taken of the Plantation there."

These "Plantations" were an attempt to colonize Ireland with English and Scotch settlers, who were called "undertakers." "Servitors" were pensioned Government servants, who were given favourable terms. The County of Londonderry was planted chiefly from London, and the Corporation of that city still owns large property there. Outside of Ulster the Plantations were not successful.

In 1611 Bodley complained that he had received no share in the division of land, and prayed for a "competent allowance" for the rest of his life. The result was that in 1612 a new office was created by Patent with the title of "Director-General and Overseer of the Fortifications and Buildings," with which was incorporated the old Patentee Office, dating from the time of Henry III. under various titles, but latterly styled "Clerks General of the Works and Buildings," and also Bodley's former Establishment office of "Superintendent of Castles." Sir Josias Bodley was appointed first incumbent of the new office,† receiving his former stipend of 20s. Irish a day.

He was again in England in 1613, having probably gone over for his brother's (Sir Thomas') funeral in March, and remained there till November. In 1615 he is given in the *List of the Army* as for "Overseeing the Fortifications."‡ Several of Bodley's official reports are among the Irish State Papers, and the very exhaustive "Observations concerning the Fortresses of Ireland and the British Colonies in Ulster" was in the Ware MSS., but is not now available.

* *Carte Papers*, Vol. XXX., Nos. 64–65.

† Privy Seal, Royston, December 23rd, 1612. 10. 11. f. R. 28. Patent, Dublin, January 29th, 1612 (1612–13). 11. Jas. I. 1a. pars. d. R. 14.

‡ Calendar of State Papers, Ireland, Vol. 233. 2. p. 11.

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On June 15th, 1615, Bodley wrote a letter* to the Lord High Treasurer of England, of which the following is an abstract, which shows that even in those days there was sometimes a difficulty in getting a travelling claim passed by the Accounts Department:—

"Apologises for pressing a humble suit upon him. Has served above three continued prenticeships in the wars, for his last refuge has betaken himself to the practise of fortification wherein it has pleased His Majesty to make use of his skill in this country with the entertainments of 20/- Irish by the day, besides which from other employments at other times, not unknown, (as he supposes) to his Lordship, somewhat accrues to him out of His Majesty's Gracious Bounty, these only being the means of his maintenance. Now it often happens then, when to his great charge he has made painful journeys in His Majesty's service, for which some allowance by concordatum is granted him from the State here, there are such delays of payment as to throw him into extreme want. It being now about a twelvemonth past since he received any penny of His Majesty's Treasury, beseeches his Lordship, in commiseration of his poor estate, to grant his warrant, either to the undertakers of the Customs, or masters of the imposts in this country, to pay him for the time past and from henceforward such moneys as he shall make appear to be due to him from His Majesty." The reply to this was that on January 19th, following, Sir R. Winwood directed Sir Thomas Ridgeway to pay Sir Josias Bodley "all his arrears either out of the subsidy or revenue of Ireland."†

Sir Josias Bodley died in Dublin, apparently unmarried, August 19th, 1617, and was buried in Christ Church Cathedral in that city. He was succeeded as Director-General of Fortifications by Capts. Sir Thomas Rotheram, Knt., and Nicholas Pinnar, who held the office jointly at a reduced salary of 10s. English per diem.‡

I am indebted to Mr. H. Tapley Soper, City Librarian, Exeter, for much valuable information. I have endeavoured to obtain a portrait of the Director-General, but without success.

* Calendar of State Papers, Ireland, Vol. 233. 30. p. 71.
† Calendar of State Papers, Ireland, Vol. 234. 3. p. 115.
‡ Privy Seal, Westminster, February 9th, 1617–18. R. 2. Patent, Dublin, February 27th, 1617–18. 15. 6a. pars. d. R. 4.

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THE R.E. HEADQUARTER MESS.

By LIEUT.-COLONEL B. R. WARD, R.E.

THE R.E. Mess at Brompton Barracks dates as an independent Corps Mess from the 1st September, 1848.

For many years previous to this, there had been a joint R.A. and R.E. Mess at Chatham, and early records show that in 1806 the number of R.A. dining members was six or eight, the corresponding number of R.E. dining members being three or four. At this time the Mess was located at Chatham Barracks, but on the 1st August, 1807, a new Mess Room—doubtless the present ante-room—was opened in Brompton Barracks. Although after the authorization of the R.E. Establishment in 1812 the numbers of R.E. officers increased very largely, Sir George Leach, the *doyen* of the Corps, writes that up to the time of joining it in 1838—when it was still under the Directorship of its founder, Sir Charles Pasley—there had not been more than two or three Engineer dining members of the Mess. His own batch was a large one, numbering 13, and together with the Honourable East India Company's Engineers from Addiscombe and the Staff of the Establishment, they brought the number of dining members up to about 26. In 1848 there were 41 R.E. officers and 23 East India Company's Engineers who were members of the Mess, as against 10 R.A. officers.

Colonel Sir Frederick Smith, Director of the R.E. Establishment, writing to the Master-General of the Ordnance on the 16th June, 1848, explains the desirability of forming an independent Mess in the following terms :—

"I need hardly remark that the officers employed at this Institution are very differently circumstanced to those who are engaged in the current duties of the Corps at the ordinary stations either at home or abroad.

"Here the officers are required to study after, as well as before, the hour of dinner, and that hour requires occasionally to be altered, according to the nature of the duties on which the young officers are engaged. For instance, at the season when the pontoon practice is being carried on the Mess hour is fixed so as to suit the tides, and is generally later than the ordinary Mess hour of other Corps. On the other hand, when 'night tracing' is the subject of instruction, or when a large number of officers are employed in the 'Astronomical Course,' the Mess requires to be fixed at an earlier hour than for the rest of the Garrison, so that in these respects it is desirable that the

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officers of the Engineers under instruction should be members of an independent Corps Mess, and bearing in mind also the youth and inexperience of the students, I conceive it would be very conducive to their benefit that the whole of the operations and machinery of the Mess in regard to the rules, regulations, and economy should emanate from the Director of this Institution.

"For these various reasons, I beg respectfully to suggest that measures may be taken for making the Mess for the officers of this Establishment and at this station an independent Corps Mess, in the same manner as that of the Royal Artillery is at Woolwich, which is the general wish of the officers under my command."

As a result of this report, and under instructions from the Master-General of the Ordnance dated 8th August, 1848, Major J. Walpole, Brigade-Major, Royal Sappers & Miners, was requested to place himself in communication with Major-General Lacey, R.A., and to make a joint report with him as to what they might consider a just and reasonable arrangement for the division of the Mess property.

General Lacey and Major Walpole in due course submitted their joint report, and on the 1st September, 1848, the Mess was placed directly under the orders of the Director of the R.E. Establishment as an independent Corps Mess.

In 1856 the headquarters of the Corps were moved from Woolwich to Chatham, and the Brompton Barracks Mess became the Corps Headquarter Mess. In 1861 the present Mess Room—including the south annexe, but exclusive of the northern annexe—was erected, the old Mess Room, now used as an ante-room, being too small to accommodate the increasing numbers present at the R.E. Establishment. The south annexe was originally divided into three parts. The centre portion formed the band room or annexe, at the western end was a butler's pantry, and the east end was used as a serving room. About the same time the billiard room was built, funds for the purpose being raised by means of debentures.

The eastern wall of the present ante-room was originally an outside wall in prolongation of the front wall of the officers' quarters on the west side of the square. The present entrance hall was designed by Capt. A. G. Clayton as Assistant Instructor in Estimating and Construction in 1882, and was erected by Lieut. J. A. Ferrier as Officer in Charge of Workshops in 1883–84. The north annexe and lavatory were added by Capt. H. W. Renny-Tailyour as Assistant Instructor in Charge of Workshops in 1887 and 1888. Soon afterwards the present serving room was built, the three rooms in the southern annexe were thrown into one in order to increase the dining accommodation of the Mess Room, and a lift room was added.

A number of oil paintings and busts—principally of Corps celebrities—have been collected during the last half-century, as shown in the following lists.

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Oil Paintings.

Subject.	Artist.	By whom Presented.
His Majesty King Edward VII., Colonel of the Corps.	H. Macbeth-Raeburn, after Luke Fildes, R.A.	The Corps.
Queen Victoria ... ... / The Prince Consort ...	Kobervin, after Winterhalter.	The Corps.
Field Marshal H.R.H. the Duke of Cambridge, Colonel of the Corps.	H. G. Herkomer ..	The Corps.
Major-General Sir William Denison, K.C.B.	C. Lutyens ...	The Corps.
Brevet Lieut.-Colonel Charles George Gordon, C.B. (as a Mandarin).	Val Prinsep ...	The Corps.
Major-General Lord Kitchener of Khartoum, G.C.B., K.C.M.G.	A. S. Cope ...	The Corps.
Field Marshal Sir John Burgoyne, Bart., G.C.B., R.E.	H. W. Phillips ...	The Corps.
General Sir Charles Pasley, K.C.B., R.E.	E. U. Eddis ...	The Corps.
Lieut.-General Sir Harry Jones, G.C.B., R.E.	E. U. Eddis ...	The Corps.
Lieut.-General Lord Napier of Magdala, G.C.B., R.E.	Sir F. Grant, P.R.A.	The Corps.
Major-General Sir J. W. Gordon, K.C.B., R.E.	C. H. Lutyens ...	The Corps.
Colonel Henry Yule, C.B., R.E. (late Bengal).	Blake Wirgman.	
Major-General Sir John Thomas Jones, K.C.B., R.E.	Bord, after Lane...	Sir Willoughby Jones, Bart.
General Sir Henry Drury Harness, K.C.B.		
Lieut.-General Sir Gerald Graham, V.C., G.C.M.G., R.E.	Poynter.	
Colonel Sir George Elliott, K.G. (First Lord Heathfield).	—	Lieut. C. M. Watson, R.E.
Field Marshal Lord Napier of Magdala, G.C.B., G.C.S.I., R.E.	Lowes Dickinson	Amy Francis Yule.
General Sir J. L. A. Simmons, G.C.B., R.E.	F. Holl	The Corps.
Colonel Charles Cornwallis-Chesney, R.E.		
General Sir Lothian Nicholson, K.C.B., Colonel Commandant, R.E.	—	The Corps.
Major-General Sir W. Green, Bart., Chief Engineer, Gibraltar, 1765—1783.		
Lieut.-General Sir Richard Fletcher, Bart., R.E.	F. Barwell ...	Field Marshal Sir Lintorn Simmons, G.C.B.

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Oil Paintings—continued.

Subject.	Artist.	By whom Presented.
Lieut.-General Skinner, R.E., Chief Engineer of Great Britain.		
Major-General Sir James Browne, K.C.S.I., C.B., R.E.	Blake Wirgman ...	The Corps.
General Sir Frederick E. Chapman, G.C.B., Colonel Commandant, R.E.	—	The Corps.
Field Marshal the Duke of Wellington, K.G.	—	Colonel Sir Francis Bolton.
Colonel Sir John Bateman-Champain, K.C M.G.	—	Members of the Indo-European Telegraph Dept.
Colonel Landmann, R.E. ...	—	Ed. J. Castle, Q.C., late Lieut., R.E.
Major-General Sir Henry Durand, K.C.S.I., C.B.		

In addition to the above, the Mess contains the following busts :—

Field Marshal Sir John Fox Burgoyne, Bart., G.C.B.
General Sir Arthur Cotton, K.C.S.I.
General Sir Richard Harrison, G.C.B., C.M.G.
Lieut.-General Sir Andrew Clarke, G.C.M.G., C B., C.I.E.
Major-General Charles George Gordon.
Major-General Sir John T. Jones, Bart., K.C.B.
Capt. Thomas Drummond, R.E., Under-Secretary for Ireland, 1835.
Vauban.

Of the foregoing oil paintings, six are hanging in the ante-room. Over the north fireplace is a fine portrait of General Sir Lintorn Simmons, G.C.B., by Frank Holl.

The following short account of his life is principally taken from the obituary notice by Colonel C. M. Watson, C.M.G., which appeared in the *R.E. Journal* for 1st September, 1903 :—Sir Lintorn Simmons was born in 1821 and died on the 14th February, 1903, and was one of the three Engineer officers who have up to the present time attained the rank of Field Marshal, the other two being Sir John Burgoyne and Lord Napier of Magdala. Although he eventually obtained this high military rank, Sir Lintorn's war services were entirely confined to his earlier career, his only employment on active service in the field being while he was a Captain in the Corps, when he was appointed British Commissioner with the Turkish Army

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during the Crimean War. "The episode of his work with the Turks during the Crimean War," writes Colonel Watson, "is really remarkable . . . He showed a knowledge of strategy and power of command, which makes one regret that he never had an opportunity of leading a British army in the field."

He was Director of the R.E. Establishment from the 1st September, 1865, to the 1st October, 1868, and immediately succeeding as he did Sir Charles Pasley and Sir Henry Harness, was the last of the three great Directors who between them made the School of Military Engineering an institution of national importance.

Sir Charles Pasley was the founder, Sir Henry Harness reorganized the schools and system of instruction, and lastly Sir Lintorn Simmons continued the work of the first two and added his own great military knowledge and experience.

He subsequently held the post of Lieutenant-Governor of the Royal Military Academy, and later that of Inspector-General of Fortifications. His last appointment whilst on the active list was that of Governor of Malta, which he held from 1884 to 1888, retiring from the Army on the 28th September of the latter year with the rank of General.

He was gazetted Field Marshal on the 21st May, 1890, and died on the 14th February, 1903.

On the west side of the ante-room are portraits of the two distinguished brothers, Sir John and Sir Harry Jones. The portrait of Major-General Sir John Thomas Jones, Bart., K.C.B., is a copy of a picture by Lane, and was presented to the Corps by his brother, Sir Willoughby Jones, the second Baronet. A short account of his life, written by Colonel R. H. Vetch, is contained in the *Dictionary of National Biography*, Vol. XXX., p. 141. He is now chiefly known by his *Journal of Sieges in Spain*, an invaluable work of reference for all students of the Peninsular War. He was *aide-de-camp* to General Leith in 1808 in Spain, and was present with Sir John Moore's force during the retreat to Corunna in 1808–09. He was in charge of the works at Torres Vedras in 1810, and on the 17th November of that year he was appointed Brigade-Major of Engineers in the Peninsula. He held this appointment until May, 1812, and was present at all the sieges undertaken during that period. He was severely wounded at the Siege of Burgos in that year, and was incapacitated for the next two years, during which time he published his famous *Journal of Sieges in Spain*.

His duties on the Headquarter Staff brought him into contact with Lord Wellington, with whom he became a great favourite.

In 1816 a convention was signed between England and the Netherlands, authorizing the expenditure by the Duke of Wellington of 6½ millions in constructing defensive works for the protection of the Netherlands. The Duke was given power to nominate as many

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inspectors as he might think necessary, and appointed Jones, who had only just been promoted Lieut.-Colonel in the Corps, as the sole inspector, sticking to his choice in spite of considerable pressure on behalf of a senior officer. Wellington generally made two inspections annually of the forts under construction in the Netherlands, and was always accompanied on these occasions by Colonel Jones.

In 1831 he was created a Baronet for his services in the Netherlands, and at the Duke's suggestion adopted a castle for his armorial bearings, with the word Netherlands as an addition. Sir John Jones died in 1843, and a statue, executed by William Behnes, was erected by the Corps to his memory in the south transept of St. Paul's Cathedral.

The portrait of Sir John's youngest brother, Lieut.-General Sir Harry David Jones, G.C.B., was painted for the Corps by E. U. Eddis. A sympathetic account of his career, written by Lieut.-General H. Sandham, occurs in the *R.E. Professional Papers* for 1868 (Vol. XVI., New Series, p. ix.). See also the *Dictionary of National Biography*, Vol. XXX., p. 105.

His earlier career in the Peninsular War from 1810 to 1814 was a most brilliant one. An interesting diary kept by him from the 20th October, 1812, to the 28th February, 1813, is published in the *R.E. Journal* for January and February, 1890 (Vol. XX., pp. 3 and 30). One "hairbreadth 'scape i' the imminent deadly breach" in 1813 at San Sebastian, where he was Adjutant of the Right Attack, is commemorated in the portrait itself. The sword in the picture is copied from the original now in the Model Room.

This sword was presented to the Corps in 1889 by the Rev. Cecil Albert Jones, last surviving son of Sir Harry Jones. Sir Harry was the Engineer officer who led the first unsuccessful assault on San Sebastian. He was wounded in the breach and taken prisoner. At the time of the second and successful assault he was in hospital with a French officer as his companion. On hearing our troops enter the town, he seized the French officer's sword, and putting it on and telling him he was his prisoner, he proceeded to cut his way out to rejoin the British forces.

The services of Sir Harry were hardly, if at all, less brilliant and remarkable than those of his elder brother.

In one respect Sir Harry Jones deserves especial commemoration, for he was the first Royal Engineer officer to be appointed to an independent command in the field. It was in 1854, when a Colonel in the Corps, that he was appointed Brigadier-General, and placed in command of the forces to be employed in the Baltic in land operations. He sailed from England in H.M.S. *Duke of Wellington*, on which ship Admiral Sir Charles Napier had hoisted his flag, and in August he landed on the fortified island of Bomarsund, in command of the

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British portion of the combined French and English force. The place surrendered after breaches had been made without waiting for an assault, and the garrison were made prisoners of war.

On his return from the Baltic he was ordered, in January, 1855, to the Crimea, where he took up the duties of Commanding Royal Engineer of the Army. "He entered upon the arduous duties of the siege," writes General Sandham, "with the same indefatigable energy and devotion that he had exhibited throughout his life in whatever service he had ever been engaged—civil or military; not a day passed that he did not visit the trenches himself, furthering by his example the devoted exertions of every member of the Corps who was employed in that memorable but lingering siege." He was severely wounded at the unsuccessful assault on the Redan on the 18th June, and although not recovered from his wound, he was carried on a stretcher to the trenches at the last general assault of the place on the 8th September.

In consequence of his wound, and of the incessant fatigue he had undergone, his general health gave way and he was invalided to England. His active career was not however at an end; the relaxation and quiet which he needed were never granted, and he died in harness as Governor of the Royal Military College, Sandhurst, on the 2nd of August, 1866, at the age of 75 years. A marble tablet is erected to his memory in the vestibule of the Royal Military College, Sandhurst, and a memorial brass in Beverley Minster, which is reproduced in the *R.E. Journal* for May, 1890 (Vol. XX., p. 119), commemorates his long and varied services.

A half-length portrait of Colonel Sir Henry Yule, K.C.S.I., C.B., LL.D. (1820—1889), hangs on the south side of the ante-room, opposite the portrait of Sir Lintorn Simmons. The portrait is an excellent piece of work, and is painted by T. Blake Wirgman. It was presented to the Corps by some of Colonel Yule's brother officers and friends in 1881. A memoir, by General T. B. Collinson, occurs in the *R.E. Journal* of the 1st February, 1890 (Vol. XX., p. 41). See also the *Dictionary of National Biography*, Vol. LXIII., p. 405, for a memoir by Mr. Coutts Trotter, and another by his daughter, Amy Frances Yule, which forms part of the introduction to the 3rd (1902) edition of her father's translation of *The Book of Ser Marco Polo*.

Yule's services in the Bengal Engineers from 1840 to 1861, including service in the first and second Sikh Wars, gained him the honour of a C.B., but it was not until he left the Service and settled at Palermo (where he resided from 1862 to 1875) that the foundation of his world-wide reputation was laid. Here great facilities existed for investigating the histories of old Italian missionaries and travellers in Central Asia, and in 1871 he brought out the first edition of his famous *Marco Polo*.

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The work earned him the gold medal of the Geographical Society of Italy, and later the founder's medal of the Royal Geographical Society. The publication at once placed the author in the front rank of geographers, and the fame of the book has increased with the lapse of time. A second edition was published in 1875, and a third was brought out after Sir Henry Yule's death by Professor Henri Cordier, of Paris, in 1902.

The book is the most famous one ever published by any member of the Corps, and the author's unique position in regard to Central Asian geography is recognized by continental writers. The style of Yule's writing, combining as it does, in the opinion of a great German geographer, elegance of form with a groundwork of scientific accuracy, in other words, indicating that the author was a literary artist as well as a scientific historian, accounts for Yule's wide influence on scholars throughout the world.

The following sonnet by Mr. E. C. Baber, a famous Chinese scholar and traveller, indicates something of the charm to be derived from Yule's *Marco Polo*, not unlike that experienced by Keats "on first looking into Chapman's *Homer*."

Until you raised dead monarchs from the mould,
And built again the domes of Xanadu,
I lay in evil case, and never knew
The glamour of that ancient story told
By good Ser Marco in his prison-hold.
But now I sit upon a throne and view
The Orient at my feet, and take of you
And Marco tribute from the realms of old.

If I am joyous, deem me not o'er bold;
If I am grateful, deem me not untrue;
For you have given me beauties to behold,
Delight to win, and fancies to pursue,
Fairer than all the jewelry and gold
Of Kubla on his throne in Cambalu.

The last honour received by Yule was his nomination by telegram from Paris as Corresponding Member of the Institute of France (Académie des Inscriptions). It was received by him on the 27th December, during his last illness, only three days before his death. On the 28th he dictated to his daughter his acknowledgment, also by telegraph, of the great honour done him by the Institute. Sir M. E. Grant Duff has justly characterized his reply as a "stately message." The message was in the following words :—

"Reddo gratias, Illustrissimi Domini, ob honores tanto nimios quanto immeritos! Mihi robora deficiunt, vita collabitur, accipiatis voluntatem pro facto. Cum corde pleno et gratissimo moriturus vos, Illustrissimi Domini, saluto.

"YULE.'

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Sir Henry Yule died on the 30th December, 1889. A bibliography of all his separate works and contributions to magazines is reprinted from the *Scottish Geographical Magazine* in the *R.E. Journal*, Vol. XX., p. 53, and a fuller and more complete bibliography occurs on page lxxv. of the Introduction to the 3rd edition of *Marco Polo*.

Next to the portrait of Sir Henry Yule hangs that of his friend and brother officer in the Bengal Engineers, Field Marshal Lord Napier of Magdala, G.C.B., G.C.S.I. (1810—1890). Although Lord Napier never touched the imagination of the English people in the same way that General Gordon did, he is one of our national heroes, and therefore needs nothing more than the barest mention. Sir Henry Yule, his junior by 10 years, could have recorded, as no one else now can, the life and deeds of his old friend, but, by a strange fatality, Lord Napier attended Sir Henry Yule's funeral only 10 days before his own death.

A memoir of his life by General R. Maclagan, another old Bengal Engineer, will be found in the *R.E. Journal* for March, 1890 (Vol. XX., p. 61), and another by Colonel R. H. Vetch in the *Dictionary of National Biography*, Vol. XL., p. 75. A portion of the *Times* obituary notice is reprinted in the *R.E. Journal*, Vol. XX., p. 27.

Lord Napier, like many another distinguished man, was one of those to whom fame came comparatively late in life. On his return to India in May, 1857, before news had been received in England of the Indian Mutiny, it was his intention to retire after three years' further service. His brilliant services during the Mutiny however paved the way for his appointment to the chief command in the Abyssinian War of 1867–68, and from that time onwards throughout the seventies he would undoubtedly have been selected as the leader of the British forces in a great European war.

In the opinion of Outram he was the finest soldier he had ever met. He was undoubtedly the greatest General the Corps had ever produced, and in military genius and charm of character he more nearly resembles that greatest of all military engineers, General Robert Lee, than perhaps any soldier in history. An equestrian statue by Boehm was erected to him by public subscription in Calcutta when he relinquished the appointment of Commander-in-Chief in India in 1876, and on his death a replica of this statue was erected by public subscription in Waterloo Place.

His funeral in St. Paul's Cathedral on the 21st January, 1890, was probably the most imposing accorded to any soldier since that of the Duke of Wellington in 1852.

Next to the portrait of Lord Napier is another full-length portrait of a famous Crimean officer, Major-General Sir John William Gordon, K.C.B. (1805—1870). During the early days of the Siege of Sebastopol he was Director of the Right Attack, the first artillery

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position of that attack being generally known as Gordon's Battery. While still a Captain in the Corps he found himself soon after the siege began, owing to several casualties, Acting C.R.E. of the Army. This position he held until the arrival of Sir Harry Jones. He was severely wounded in the sortie of the 22nd of March, 1855, a wound which gave him incessant suffering until his death in 1870. Nicknamed "Old Fireworks" by the Naval Brigade in the Crimea, he was indefatigable and almost Napoleonic in his capacity for continued exertion.

An interesting account of his character and career is given in C. C. Chesney's *Essays in Military Biography*, and another memoir by Colonel R. H. Vetch appears in Vol. XXII. of the *Dictionary of National Biography*.

(*To be continued*).

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VOLUNTEERS IN THE 18TH CENTURY.

THE following document is probably one of the earliest to refer to volunteers for Harbour Defence Work, and as such will prove of interest to the Corps. Its date is between 1780 and 1790.

We whose Names are hereunto Subscribed (Inhabitants of the Town and Port of Dover) from a Consideration of the Danger to which the Coast is exposed of Invasion by the Enemy, and of the Situation of this Town and Port in particular, do hereby Agree, promise, and Engage, that We will at all times Necessary, stand forth in defence of Dover Town and Harbour and the Works there Erected, and to enable us for such Service, will at convenient times to be appointed for that purpose, Assemble to learn the Exercise of the Cannon and small Arms under the Command of the Officers under mentioned and Agreeable to the proposals following

1st. That this Association shall with all speed be encreased to Six Companies of Sixty Men Each; every Company to be Commanded by a Captain and two Lieutenants (Members of the Association).

2nd. That such Captains and Lieutenants be Authorized by Commissions to be Obtained from His Majesty for that purpose.

3d. That these Proposals, or the Acceptance of such Commissions shall not render the Association or any of them, liable to be called forth on any other Service than for the Defence of the Town; or to the Controul or Command of any other Officer or Person Civil or Military Save that of a Superior Military Officer in time of Action, but that the Association and Services to be performed by them, shall at all times be considered as Voluntary and Independant.

North Battery.

Captains.	1st Lieutenants.	2nd Lieutenants.
Thomas Solly.	Alexr. Veale Ridley.	Thomas Huntley.
Edwd. Thornton.	Edward Godier.	Benjamin Easter.

Pier Battery.

Thomas Wilkison.	Edwd. Atherden.	Joseph Luddington.
Brook Samson.	William Wallace.	Willm. Luddington.

Pilot-house Battery.

Henry Ladd.	Edwd. Ladd.	Henry Ladd Junr.
Thomas King.	Christopr. Friend.	Michl. Becker.

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NOTICES OF MAGAZINES.

Journal des Sciences Militaires.

September 1st, 1908.

The number opens with the third instalment of a "Strategical Criticism of the Franco-German War," by L. C. Grouard. The period under consideration is from August 7th to August 12th, 1870. The movements of the French are given, and the plan adopted—together with several alternatives—is criticized. The Emperor is described as being unable to make up his mind, and as finally deciding, against his own judgment, in favour of the ideas of the leading engineer and artillery officers. Their advice is ascribed to the doctrines of General Brialmont (whose system has been specially criticized in Sir George Clarke's *Fortification*).

A continuation of an article on "Dagsbert, a Military Author," gives a review of a book published by him in 1790 entitled *L'Ordonnance Francaise*. Among the points touched on are the establishment of a military college; the institution, for the Prussian system of flogging, of rewards or punishments appealing more to soldiers' patriotism and sense of honour; heavier penalties for desertion. Leaving troops in garrison at the same place for many years is condemned, as leading to desertion from sheer boredom. More fresh air in hospitals and some form of "first-aid" instruction for the men is recommended. The part restoration of armour in order to give more confidence to the men, and the substitution of a heavy sword or short pike in place of the officers' court swords is also suggested.

An article by Lieut. Archer on "Dirigible Balloons," begins by quoting opinions for and against their use as a method of offence. A discussion follows on the various forms of projectiles, and the question of the equilibrium of the balloon on losing the weight of the projectiles, is considered. The conclusion arrived at is that a dirigible can, without any exaggeration, render considerable service. The moral, rather than the material effect, is counted upon, though there should be many opportunities of damaging docks, magazines, etc. Captive balloons are looked upon as the special prey of the dirigible. A short criticism of Zeppelin IV. follows, and the conclusions arrived at are somewhat different to those of Mr. Newcomb in the *19th Century*.

A short article on the "Natural History of Discipline," considers it to be the "condition which renders the maintenance of life possible." From the first, rules have been imposed on the mind, and have become natural by heredity. "Example is the foundation of all good education."

In the "Prolongation of School in the Regiment" a list of suitable subjects for lectures is given, together with some hints on lecturing. Abstract words should be avoided—use those which awake associations in the popular mind. A series of popular textbooks is suggested, to be

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chosen by a committee, and to be published anonymously so as to avoid jealousy. Finally, the danger is pointed out of the destinies of the state being decided by ignorant voters.

The "Campaign of Styria in 1809" contains in this number the Siege of Gratz, by Macdonald and Broussier, from the 1st to the 21st of June, when the movements of Giulay caused the siege to be raised.

H. L. WOODHOUSE.

REVISTA DE ENGENHERIA MILITAR.

June, 1908.

REORGANIZATION OF THE ENGINEER TROOPS.—By Capt. A. Filippe da Costa.—Recent events have shown the necessity for the reorganization of the Portuguese Army. New engineer units are required in connection with wireless telegraphy, ballooning, search lights, and mechanical transport.

The period of service with the colours of engineer non-commissioned officers and men is too short and should be increased, as it is impossible to instruct them thoroughly in their duties in the time now available.

The existing regiment of engineers, formed of companies of sappers and miners, telegraphists, pontoniers, and railway engineers, should be divided up into homogeneous groups, stationed at places possessing special facilities for the instruction of the rank and file.

The three additional companies required to complete the establishment of 1901, should be formed, or, if this is not possible, at least one company—for which the necessary material already exists—should be raised immediately.

CENTENARY OF THE PENINSULAR WAR.—The programme of the celebration of the centenary of the Peninsular War has been issued. The following are the more important events:—

1908.—Civic commemoration of the national rising for the re-establishment of independence, held at Oporto on the 19th June. The centenary of re-establishment of the national government at Lisbon will be celebrated on the 15th September in that city.

Commemoration of the Battle of Vimeiro on the 27th August.

1909.—Commemoration of the defence of the Minho. Erection of a memorial to General Bernadine Freire and to Champalimand at Caminha on the 16th February.

Commemoration of the siege and capture of Chaves, 20th—25th March.

Commemoration of the defence of the bridge of Amarante, 18th April—2nd May. Erection of a memorial at the site of the bridge.

Commemoration of the passage of the Douro and the recapture of Oporto by the Anglo-Portuguese Army on the 12th May. Foundation stone of a memorial to be laid.

1910.—Commemoration of the Battle of Bussaco. Grand celebration at Bussaco and Lisbon on the 27th September.

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1911.—Commemoration of the defence of the fortresses of Abrantes (9th October—7th March) and of Campo Maior (12th—22nd March). Erection of memorial tablets at these places.

1914.—A large money prize will be given to the author of the best work on a subject connected with the Peninsular War, written during the period of the commemoration, and honorary distinctions will be conferred on the authors of other essays favourably mentioned by the committee. Competitors must send in their work before the 31st October, 1913. The King will be asked to present the prizes on the 10th April, 1914, the centenary of the Battle of Toulouse.

The dates of other celebrations have not yet been fixed, but it is proposed to send a general officer to London to place a bronze wreath on the tomb of the Duke of Wellington, to hold an exhibition of maps, books, and documents relating to the war, the publication at the public expense of all documents relating to the war, etc., also commemorations of the defence of the lines of Torres Vedras, and of the Battles of Talavera, Fuentes de Honor, Albuera, Salamanca, Vitoria, Nivelle, Ortez, and the Sieges of Badajoz, San Sebastian, and Ciudad Rodrigo.

HARMONIC SYNTHESIS OF THE TIDES (*continued*).

SOME PROJECTS AND WORKS EXECUTED IN THE PROVINCE OF MOÇAMBIQUE (*continued*).—Contains a description of the construction of three light-houses, viz., (1), at Ponta Vermelha, Lourenço Marques, of brickwork; (2), at the Ilha dos Elephantes, at the entrance to Lourenço Marques, of iron; (3), at Ponta Macuty, at the entrance to Beira, of brickwork.

'M.'

REVUE DU GÉNIE MILITAIRE.

June, 1908.

THE FOREIGN MILITARY ESTABLISHMENTS IN CHINA.—A continuation of the previous articles. The writer describes the British barracks at Tientsin. These were built by a civil company under the following terms: (1) the lease to be for 2½ years certain, and (2) the rent to be $2,800 (silver) a month. It is hoped that after the barracks have been evacuated by the troops they will be taken by Chinese tenants. The writer considers this a very practical and economical arrangement from the British taxpayer's point of view, but not so satisfactory for the troops, as the barracks have been built to Chinese rather than European standards.

Then follows an account of the Austrian barracks in the Legation quarter at Pekin. The most noteworthy detail is the defensive wall which protects the Legation. At the back of the wall is a thick earthen parapet, which in the first instance forms a banquette for the defenders of the wall. As the wall is demolished by the attacker's artillery the *débris* will fall forward and unmask the earthen parapet, which forms the true line of defence.

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THE MILITARY TRAINING OF AN ENGINEER COMPANY.—A continuation of a previous article. The author suggests various exercises in scouting, outposts, and other minor tactical operations.

July, 1908.

THE MILITARY TELEGRAPH IN MOROCCO.—About 300 kilomètres of air line were constructed by the French Engineers in the spring of 1908, to connect Casa Blanca with posts in the interior. The line consisted of 3-millimètre galvanized iron wire supported on 18-foot poles. The rate of construction averaged about 4 kilomètres per working day. In many places the soil was so rocky that the holes for the posts could only be made by blasting.

Visual signalling was used in the first instance, until the telegraph line was laid. The apparatus employed was apparently a heliograph fitted with an acetylene lamp for night work. The visual signalling apparatus is now held in reserve in case of interruptions to the telegraph line, and also for the use of field columns.

Before the construction of the telegraph line considerable use was made of wireless telegraphy. One station was installed at Casa Blanca and the other at Ber Reshid, 40 kilomètres distant. Communication was perfect. At night the Ber Reshid station was able to receive messages from the Eiffel Tower. The mast used for the Ber Reshid station was 91 feet high. A mobile wireless station was also organized and used; it had a range of 25 to 30 kilomètres. The current was supplied by a portable dynamo. A 97-foot portable steel mast was employed. The largest traffic dealt with was 2,000 words a day.

Various short telephone lines were used for the internal communication of the more important posts.

THE FOREIGN MILITARY ESTABLISHMENTS IN CHINA.—A continuation of the previous articles. This number is devoted to the Japanese. The commissariat is responsible for the building and maintenance of barracks in the Japanese Army, and the work is done entirely by civilian contractors. In the Pekin Legations the Japanese officers are each provided with two rooms, no matter what their rank. In addition there is an Officers' Mess containing an ante-room, dining room, reading room, billiard room, etc. In the men's barrack rooms the beds are arranged in two tiers with a horizontal distance of only 2 feet between the beds. A shelf is provided for the men's kits. The furniture consists of tables, benches, and a few cupboards. In the verandah is a shelf for the men's boots; they are not allowed to wear them in the barrack room. All cooking is done by steam, which is supplied from the electric light boilers. The general upkeep of the buildings leaves much to be desired.

At Tientsin the Japanese troops are quartered in the Western Arsenal, and most of the material for the barracks was furnished by the ruins of the Arsenal buildings. These barracks are more spacious than those at Pekin.—*To be continued.*

J. E. E. CRASTER.

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RIVISTA DI ARTIGLIERIA E GENIO.

June, 1908.

MISCELLANEA.—THE MILITARY BALLOON SERVICE IN THE AUSTRO-HUNGARIAN ARMY.—Under the title "Das Luftschifferwesen in Oesterreich-Ungarn" the official journal *Allgemeine Schweizerische Militärzeitung* of 21st May has published an article on the military balloon service of the Austro-Hungarian Army.

In the Austro-Hungarian Army the balloon service is entrusted to separate detachments, which, according to their employment, are distinguished as field balloon detachments and fortress balloon detachments.

In peace time some of the regiments of fortress artillery have small squads attached to them, which on mobilization of the army are capable of being organized into eight fortress balloon detachments; three field balloon detachments are further employed directly under the military aeronautical section.

At Vienna, at the end of 1893, an establishment for military aeronautics was formed and attached to the 1st Regiment of Fortress Artillery (in the Vienna arsenal). The permanent *personnel* of this establishment consisted of:—1 commissioned officer as commandant, 1 under officer, 3 selected artillerymen, 3 ordinary gunners, and 1 attendant. At this establishmnet a special course of military ballooning, lasting for a few months, is held every year.

The *personnel* for the field balloon detachments is recruited from the officers of all branches of the service and from men of the artillery and technical troops who have attended the said course. The saddle horses for the officers and under officers, as well as the draught horses, are supplied from the artillery. In time of war the balloon detachments are distributed among the army corps and divisions. In field warfare the balloon detachments are employed essentially for tactical reconnaissances, and only in exceptional cases for artillery service.

The commandant provides according to circumstances for the dislocation of the balloon detachment on the march, arranging for the transport by the best roads available on account of the heavy wagons employed by the detachment.

During the march previous to a battle, the balloon detachment is to take post with the advance guard of the leading division. The order for the ascent is given by the commander of the troops, who also determines the place and the moment of ascent, and who arranges for the manner in which the results of the observations are to be communicated. The aeronaut, before the ascent, should be made acquainted by the chief of the general staff or other staff officers with the general situation and the views of the commander-in-chief.

During the battle the balloonist should be employed in carefully communicating details of the opposing force and of the dispositions of the enemy's columns. In an attack on an enemy in position the balloon should be located conveniently for making observations of the dispositions of the enemy's reserves, and also of what is going on behind the firing line.

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In the defence the balloon ascent should be made near the front of the position, telephonic communication being kept up between the observer in the car and the commander of the troops. The inflating stations should be located out of range of artillery fire, sheltered as much as possible from the wind. In field warfare it is not often possible to avoid the place of ascent being within range of the enemy's fire.

The commander of the balloon detachment should keep himself in continual communication with the commander of the troops. On the march the former, together with his observers, are placed on the staff of the latter. When the balloon is in the air the commander of the detachment should not be far from the place of ascent. The time during which the balloon is to remain in the air is decided by the commander of the troops.

The fortress balloon detachments are attached to the artillery corps stationed in the fortified places, and are at the disposal of the commander of the fortress, to be used partly for purely tactical work and partly for observation service for the artillery.

It is necessary to establish a convenient station for the inflation of the balloon and a place for its ascent. In view of the great quantity of water required—about 30,000 litres—and for the transport of the material for inflating a balloon of 600 cubic mètres, the station should be in the immediate vicinity of an abundant supply of water, and also of good communication roads.

The place of ascent should be distant about 4,000 mètres from the enemy.

During the attack the balloonists for the defence should furnish the commandant of the fortress with information as to the strength and dispositions of the attacking force, the railway stations where material is unloaded, the field railway lines, and other lines of communication, and the position of the parks, etc.

Free balloons are used for the transport of persons, letters, and pigeons travelling from a blockaded fortress to places not occupied by the enemy. The pigeons are used for the transmission of messages from the outer world to the interior of the place.

The attacking force is also able to reconnoitre parts of the fortress, which otherwise they would not be able to explore, by means of free balloons.

The despatch of a free balloon naturally means its loss to the fortified place, and it can only take place by order of the commandant of the fortress.

The material of the balloon detachments consists of cylindrical balloons (Drachenballons) and of spherical balloons. The cylindrical balloon of 600 cubic mètres consists of the outer envelope and the rigging with car attached—it weighs 322 k.g. The balloon is of cylindrical form with hemispherical ends. It is furnished with a kind of rudder at the back of the balloon. Two bags are carried in the car containing instruments, maps, an aneroid, a knife with hook, two signalling flags, two bags of ballast, a securing rope, and various tools.

The spherical balloon of 600 cubic mètres (M. 96) consists of the outer envelope, and weighs 214 k.g. with netting and car complete; that

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marked M. 98 weighs 235 k.g. For rapid inflation the balloon is furnished with a special apparatus. A square mètre of the outer envelope weighs ½ k.g., and costs 4¼ marks.

For free ascents other spherical balloons of 600 cubic mètres are used. Some of these, constructed at the time at which they are required, may be of 1,000 and 1,300 cubic mètres.

For restraining the fixed balloon a hollow steel wire of 500 to 600 mètres and diameter of 8 millimètres is used. The isolated conductor for the telephone is within the wire. Telephonic communication is carried on between the observer in the balloon and the stations on the ground. For signalling during the day two hand flags are used, one red and the other white; during the night an electric signalling apparatus is used, consisting of a battery and an electric incandescent lamp connected with a conducting wire. With a charge to the battery of 0·23 litres of solution the lamp can work for eight hours.

EDWARD T. THACKERAY.

THE GEOGRAPHICAL JOURNAL.

WADE'S METHOD OF DETERMINING LONGITUDE.—*The Geographical Journal* for July, 1908, describes a new absolute method of determining longitudes by observation of lunar distances, devised by Mr. E. B. H. Wade, M.A., of the Egyptian Survey Department. An illustration of the special "Field Longitude Instrument" is given. This may be briefly described as follows:—A suitable telescope, mounted horizontally, and capable of rotation both in azimuth and about its own axis, bears in front of its object glass a "field mirror" which reflects the line of sight through 90°. Attached to the field mirror is a box sextant which can be rotated about the reflected line of sight as axis. The sextant mirrors are so designed that when the line of sight is directed towards a star, the ray from the star reaches the eye without being reflected by the sextant mirrors*, while at the same time these mirrors can reflect the rays from the moon, *viâ* (in succession) the index, horizon, and field mirrors, to the eye. The index, on the index mirror, reads on a small scale graduated to degrees as no more exact reading on the scale is needed.

Attached to the telescope is a "finder," a small telescope whose axis is parallel to the line of sight of the main telescope as reflected by the field mirror.

To make an observation two stars are selected near the ecliptic, one preceding and one following the moon, and nearly equidistant from it. (For this purpose a programme is prepared similar to that required for observation of occultations of stars).

The telescope is laid on to the first star by the finder, the index mirror being clamped at the estimated angular distance of the moon from the

* The construction of the sextant, whereby the star and moon are observed simultaneously, is not described, but it is inferred that the index and horizon mirrors are translucent, and permit of the passage of the direct light from the star, while reflecting the brighter image of the moon.

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star. The sextant is next rotated till the images of both moon and star come into the field of the telescope. The observer then waits for the star and the moon's limb to make contact, and notes the L.M.T. Keeping the index clamped at the same angle, the telescope is laid onto the second star, and the moment of contact of moon and star is again noted. The local times of a pair of lunar equidistances so obtained which are not simultaneous are used for the computation.

Three observations of contact with each of the stars are made at each operation without shifting the index. This is done by means of a prism, which can be interposed between the horizon and index glasses. This prism deflects the ray from the moon through a very small angle, and, according as it is placed into one of three possible positions, three different deviations of the ray are obtained, and three moments of contact can be observed. The mean of the times of the three observations is taken for the computation, and the chance of error is thereby greatly reduced. The manipulation is said to be quite simple.

The computation consists in assuming a value for the longitude, and calculating the apparent distances of the two stars for this assumed longitude, at the local times as noted. If these two apparent lunar distances are not equal to one another, then the difference is halved, and the half-difference is the measure of the correction to be applied to the assumed longitude. If the differences are very great (*i.e.*, if the assumption was very incorrect), then it will serve as a guide for a more accurate assumption, working with which the operation can be repeated.

The calculation is generally similar to that used for calculating longitude by occultations.

As the opportunities for taking observations are numerous, and as these have not to be made at any one particular moment, the method described possesses manifest advantages.

After allowing for errors due to the inaccuracy of the lunar tables, or of the clock time and for known personal or instrumental error, the residual probable error in the determination of longitude from a single pair of lunar equidistances is said to be as little as 22·5″ of longitude.

A. H. D. RIACH.

VOËNNYI SBÓRNIK.

May, 1908.

THE RAILWAY ALONG THE AMUR.—Russia's importance in the Far East is dependent on the means of communication between Europe and the Pacific Ocean. At present there are four routes:—

(*a*). The route by sea along the southern coast of Asia.
(*b*). The Arctic Ocean.
(*c*). A mixed route by the Siberian railway as far as Stretensk and thence by water along the rivers Shilka and Amur.
(*d*). By rail along the Siberian and Eastern Chinese railways.

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From a military point of view the first two are impracticable. As regards the third, navigation is possible during five months of the year; during other four the rivers are frozen and communication can still be carried on, but any traffic during the remainder of the year is impossible. This route might have serious disadvantages in time of war, because the Amur for a considerable distance forms the boundary between Siberia and China; its right bank is not therefore Russian property.

The fourth route (*d*), so far as the Eastern Chinese railway is concerned, is now barred for strategical purposes by the Treaty of Portsmouth, and moreover—since the war with Japan—the prestige of Russia has declined and the line is in danger of being destroyed; the number of troops for its protection is limited by the same Treaty to 15 men per kilomètre.

An unbroken line of railway from Europe to the Pacific passing entirely through Russian territory is an economic and military necessity, and the first surveys for a railway along the Amur were carried out in 1893—1896. It was then proposed to carry it along the beds of the Shilha and Amur Rivers. This line however presented many difficulties; it would have involved the construction of 20 tunnels up to 2 miles in length and one of 3 miles, and of many large embankments.

Later surveys were made in 1906—1907 under great climatic and physical difficulties. The projected line lay at some distance from the frontier—a better course than the first from a military point of view.

The question of the construction of the line was discussed in the Duma; it has been decided that the new line is to start from the station Kueng, on the Trans-Baikal line, and to extend as far as Khabarovsk,* at the junction of the Amur and Usuri Rivers, with a branch to the town of Blagovyeshchenk, on the Amur, along the bank of the Dzeya.

A sum of 750,000 roubles has been voted this year for carrying out additional surveys from the Bureya to Khabarovsk, and for investigating the best means of crossing the Bureya and Amur at Khabarovsk. Also for making detailed maps of the whole of the area along the Amur for a width of 84 miles.

The railway is to have the same carrying capacity as the rest of the Siberian line. The limiting gradient is to be $\frac{1}{100}$; the smallest radius of curve, 1,400 feet, occasionally 1,050 feet. The weight of the rails is 73 lbs. per yard run. The total length of the line from Kueng to Khabarovsk will be about 1,850 versts (1,226 miles).

A. H. BELL.

* A line between Khabarovsk and Vladivostok already exists.—A. H. B.

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A FEW PRESS (and other) OPINIONS.

The Editor in *The Nation in Arms*, the Official Journal of The National Service League, in writing to the Editor of "Defenders of Our Empire," under date of July 31st, 1908, states:—"He is very much struck with the quality and form of the new Publication."

The Morning Post, July 31st, 1908, says:—"A handsome new Quarterly has made its appearance, entitled 'Defenders of Our Empire,' and edited by Mr. C. Gilbert-Wood."

The Editor of several well-known Publications, and a Journalist of 45 years' experience, writes:—"I consider this work to be unique, and beautifully 'got up'; it certainly 'should be read by all who love their country.'"

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Although only published a week or two since, "Defenders of our Empire" has already been very favourably noticed by *The Times*, *The Standard*, *The Field*, *The Westminster Gazette*, *The Regiment*, and many other London, Provincial and Foreign Journals.

Further particulars as to Future Contents, etc., will be published in due course.

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STAFF COLLEGE, AUGUST, 1907.

The following Officers, whose names are arranged in regimental order, were successful from us at the recent Competitive Examination for admission to the Staff College:—

Capt. J. S. Cawley, 20th Hussars.
,, E. M. Birch, D.S.O., Royal Field Artillery.
,, P. W. Game, Royal Horse Artillery.
,, and Brevet Major C. B. Thompson, Royal Engineers.
,, R. Ommanney, Royal Engineers.
Lieut. G. P. Dawnay, M.V.O., D.S.O., Coldstream Guards.
Capt. W. Drysdale, Royal Scots.
,, G. H. B. Freeth, D.S.O., Lancashire Fusiliers.
,, R. S. Allen, Lancashire Fusiliers.
,, B. H. Chetwynd-Stapylton, Cheshire Regiment.
Capt. A. Crookenden, Cheshire Regiment.
,, and Brevet Major I. Stewart, Scottish Rifles.
Lieut. H. Needham, Gloucestershire Regt.
Capt. E. R. Clayton, Oxfordshire Light Infantry.
,, J. C. H. Newman, Essex Regiment.
,, L. A. E. Price-Davies, V.C., D.S.O., King's Royal Rifle Corps.
,, W. E. Davies, Rifle Brigade.
,, L. R. Vaughan, Indian Army.
,, J. Brough, Royal Marine Artillery.

The following Officers received nominations:—

Capt. the Hon. C. H. C. Guest, 1st Dragoons.
,, and Brevet Major E. D. Lord Loch, M.V.O., D.S.O., Grenadier Guards.
,, R. H. Mangles, D.S.O., Royal West Surrey Regiment.
,, H. W. Grubb, Border Regiment.
,, G. N. Cory, D.S.O., Royal Dublin Fusiliers.
,, G. D. Bruce, Indian Army.

WOOLWICH, NOVEMBER, 1907.

THIRD	F. N. M. Mason	7,441	27th	H. W. Crippin	6,411
FIFTH	E. J. Moorhead	7,236	32nd	L. H. King-Harman	6,372
SIXTH	C. W. R. Tuke	7,166	35th	R. B. Pargiter	6,339
24th	J. R. Pinsent	6,493			

This is the second time in two years we have passed THREE out of the first SIX for Woolwich

SANDHURST, NOVEMBER, 1907.

12th	C. W. Maxwell	5,172	27th	C. T. Ellison	4,912
13th	R. C. Money	5,169	38th	B. C. H. Keenlyside	4,644

CAVALRY, NOVEMBER, 1907.

7th ... ... A. M. Sassoon 3,481

WEST INDIA, NOVEMBER, 1907.

SECOND ... ... F. T. Hughes 4,331

INDIAN POLICE, JUNE, 1907.

THIRD	F. W. Toms	6,886	27th	H. W. Waite	5,980

ARMY QUALIFYING, MARCH, 1908.

Six were successful from us.

MILITIA COMPETITIVE, MARCH, 1908.

Douglas Scott, Kent Artillery.
D. G. Gunn, 3rd P.W.O. West Yorkshire Regiment.
A. L. Cooper Key, 5th Middlesex Regiment.
W. C. Loder Symonds, Lancashire Field Artillery.
R. G. Atkinson, West Surrey Regiment.
R. W. Leach, Cambridge Volunteers.
G. W. Courtney, Cork R.G.A.

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ENGINEER SCOUTING AND RECONNAISSANCE.

By MAJOR F. E. G. SKEY, R.E.

THE complaint is often heard that little use can be made of the services of Engineers in peace operations. While studying how this defect may be remedied, it is suggested that a great deal may be done by the increased development of Engineer scouting and reconnaissance ; for although it is true that only a small proportion of the men can be actually employed on such duties, yet the reports obtained would in all probability reveal useful work for the remainder, which can either be actually completed, or at any rate carried to the point of the distribution of the working parties.

The suggestions made in the following article deal with the subject from the point of view of peace training only, although at the same time it is recognized that on service, in future campaigns, Engineers will be expected to possess a very high standard of reconnoitring skill, on every subject which affects their own line as artificers and fortification experts, and that this can only be obtained by paying special attention to such details in peace time.

The first essential point to be realized, is that all officers and N.C.O.'s of the field companies should be thoroughly trained in all kinds of Engineer reconnaissance duties, and should be able to report clearly and concisely, either by a rough sketch or in writing, on any details and information which they may have acquired.

In addition to this, a small proportion of N.C.O.'s and men should be specially trained as scouts. They should be young and active men, equally at home on bicycle and horseback, and after a period of training they should be subject to special inspections, and competitions and prizes should be offered to test their efficiency.

So much for the men. We will now turn to a consideration of their work on the march, in camp, in defence and in the attack.

On the march the Engineer scouts should be pushed as far to the front as possible, to obtain the earliest information of any obstruction to the march of the advancing columns. If the line of march passes through any important defile, bridge, or mountain pass, it would be useful to send forward special men to report. If it is a bridge, a full description of it should be prepared with a scheme for its demolition, and information as to the resources of the neighbourhood for its repair if it should have been demolished. If a mountain pass, whether it is blocked and requires clearing, or how it can be

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blocked or mined, and what important parts of the line can be demolished in case of a retirement.

The resources of towns and villages passed through, in bridging or hutting materials and smithies, etc., should be noted, and stores of stone, brick, or road metal along the road or in neighbouring kilns or quarries should be reported upon. Information on such points should be accumulated in the hands of the C.R.E., and some of it could not fail to be subsequently useful.

The reconnaissance of a line of river or mountain range would probably be carried out rather from a halt than on the line of march. Here, for the purposes of the reconnaissance, the line should be divided into sections among several officers or N.C.O.'s.

For a river, information would be required as to existing fords and bridges, boats, stores of bridging materials, sites suitable for bridges, with special reference to the approaches on both banks, and details as to sections, and the condition of bottom and banks.

If the line of the river is held by the enemy, the gathering of this information may require a considerable amount of skill and ingenuity, and men possessing a natural aptitude for this kind of work can only be found by practice.

The information required about a mountain range would include descriptions of the various roads and bridle-paths, their gradient, state of repair, and suitability to the various kinds of transport. The materials at hand for their repair and their capacity for obstruction, whether by means of obstacles, demolition, or defensive works, may also be noted.

Turning now to the reconnaissance of camps, the Engineer points of research are the approaches, the water supply, and the approaches to the latter. As regards approaches, existing entrances may require widening, or fresh gaps may have to be cut, and in this connection it would be useful to find where brushwood can be cut for making fascines and mats for the bad places which often grow in the entrances to camping grounds. The watering places for drinking, horse watering, and washing must be decided upon, and the requirements in pumps, troughs, and other arrangements settled. Here everything has to be done in a hurry, in order that there may be no block on the road or delay in watering the horses when they get in; but the Engineers need not rest content until all possible sources of water supply and all possible approaches which may relieve congestion in the watering, feeding, or moving of the troops have been examined and reported on.

If other possible camping grounds are known of within the area occupied by our troops, reconnaissance parties should be sent to report on them, in order to increase the store of information in the hands of the C.R.E.

The camp may depend for its supplies upon a railway, and in this case the stations should be reported on as to platform accommodation

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and materials available for making additional platforms and sidings. If the supplies are conveyed by river or canal, the wharves and landing stages should be reported on, and the resources available for erecting others, or for increasing the accommodation of existing ones. The reporting on a line for a possible tramway to be made between a railway station or wharf and a supply depôt, would come within the scope of Engineer reconnaissance.

In the *defence* Engineer reconnaissance falls under the two general headings of (i.) the selection of the position and (ii.) the execution of the works. It is possible that the Engineers may not be consulted in the selection of the position or in the siting of the various works, but none the less it is their business to be specialists on these subjects, and the better specialists they are, the more likely are they to be consulted. For this reason the selection of defensive lines and the siting of trenches, etc., is a branch of our training which should be exercised on every possible occasion.

But while (i.) is going on, there is a great deal to be done under the heading of (ii.), in preparation for the execution of the works. A careful reconnaissance of the neighbourhood should be carried out, to bring to light all stores which can be utilized in the defence, and to find how they can be conveyed to the position. Sawn timber of various scantlings, suitable for revetments and head cover, corrugated iron, sacks, timber growing or cut, suitable for stakes, and wire, both plain and barbed; tools; labour and carts; brushwood for revetments and fascines—these last with brick or stone may be required in approaches, or in gun emplacements; gravel for use in the head-cover sandbags; water receptacles; paint. These should be reported on and arranged for each section of the defence separately, and in each section a site for the Engineer park must be selected where materials can be brought up and distributed, and where tools can be repaired, stakes cut and sharpened, and other rough work carried out.

The Sappers in the defence would probably be extensively distributed, and it is hardly probable that they would be charged with the construction of any of the entrenchments, even in the most important parts of the position; but the obstacles, including land mines, flares, and alarm guns, would probably be entrusted to them, and they might help in the construction of covered communications, blindages, and head cover, while the approaches to and floors of gun emplacements, especially for the Long Toms, might also require their assistance.

But it is in the *attack* that the most important reconnaissance work will be required of the Engineers, and probably no attack will be carried out in future until the most minute technical details have been ascertained. It is here, more than anywhere, that the Engineer must decide how he can help forward the success of the operation.

In the first place he will look for natural obstacles, streams, bogs,

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etc., which the attack will encounter in its advance, and how and where they are to be crossed, what roads will carry infantry and what artillery, and where preparations must be made for the passage of the various arms.

Next there are the artificial obstacles, what they are and where placed. All details must be very exact, and localities must be selected for pushing in clearing parties to demolish them. Incidentally the other defence works may be noted, but the obstacles, and how to get the troops through them, is essentially the problem of the Engineer. It is not easy to get training at this work, and no opportunity should be lost when troops are entrenching to exercise Engineers, officers and N.C.O.'s, in advancing under service conditions and making large-scale sketches of the works, as far as they can ascertain them, in the short sections within their immediate purview.

Another subject for reconnaissance in the attack is the selection of *points d'appui* or pivots, which may have to be seized and entrenched in order to secure a foothold within the enemy's position. It is possible that the selection may have been already decided, but even this important decision may sometimes await the result of the Engineer reconnaissance. The work of fortifying these points, when once taken, would probably be entrusted to the Sappers, who would therefore, with the exception of the parties detailed to clear obstacles, be massed in the attack, though disseminated in the defence. The reconnaissance would have to decide how the men and tools can be pushed forward; what tools are likely to be required, what proportion of picks, shovels, jumping-bars, and felling-axes; whether wire and stakes are available on the spot or must be brought up; how far the tool carts and store wagons can be brought, and by what line. Some idea must be formed of the perimeter to be occupied and what class of works is to be attempted. The capture will probably take place early in the night, and the more complete the arrangements made beforehand, the greater the amount of work which will have been done before the arrival of the inevitable counter-attack.

There is therefore a great deal that can be done on manœuvres in the way of reconnaissance and scouting, and it is probable that, as a result, all ranks of the field companies would find abundant employment; in fact it might even be considered advisable to make up the companies for manœuvres to nearer their war strength, by drafts from the Territorials or by some other means.

In this article suggestions for the outlines of this important branch of our training have been roughly sketched, but much more might be written about the special reconnaissance duties, not only of the field companies, but also of the telegraphs, railways, and other technical branches of the Corps.

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STUDIES ON THE USE OF FIELD TELEGRAPHS IN SOUTH AFRICA.

By MAJOR E. G. GODFREY-FAUSSETT, R.E.

V.—SEMI-PERMANENT TELEGRAPHS IN GUERILLA WARFARE (THE BLOCKHOUSE SYSTEM IN THE TRANSVAAL).

DURING the last year of the war the telegraph organization had a semi-permanent aspect. The disturbed area was divided into four divisions—Cape Colony, Natal, Orange River Colony, and Transvaal—each under a local Director. Two Clearing Houses were established, one at Bloemfontein and one at Pretoria; Cape Colony being attached to Orange River Colony, and Natal to the Transvaal for this purpose.

The following is a description of the organization established in the Transvaal, and modelled as far as possible on the organization of the Post Office in England.

The Administration occupied in Pretoria a bungalow which had been taken over from the Boer Telegraphs. There were four departments:—

(*a*). Engineers.
(*b*). Surveyor.
(*c*). Accountant.
(*d*). Stores and shops.

The Engineering branch was controlled by the Director, with one or two subalterns as assistants. Every new work was estimated for on a printed form by the Inspector concerned, and was allotted a numbered Works Order, to which all stores or cash payments were charged. The Works Orders were lettered according to the nature of the service—telegraphs or telephones; military, civil administration, or private (paid)—and were numbered consecutively in each class.

The Surveyor's branch, under a civilian, was responsible for (1) the control of the traffic generally; (2), the issue of the necessary circulars and instructions as to the complicated and constantly varying rates for telegrams to and from cable companies and other administrations; (3), for the collection and handing over to the Clearing House of office copies of telegrams; (4), the control of the very numerous civilian staff.

The Accountant's branch dealt with all money matters except the pay of soldiers, which was kept on an ordinary pay list. Five thousand pounds a month were drawn on imprest from the Army

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Pay Department, and the receipts for private telegrams and rent of private telephone lines were very considerable—telegrams amounted to £41,592 and telephones to £30,236 during the whole period.

The Storekeeper had charge of all spare stores, whether found in the country, received from Ordnance, or purchased, and issued them as required, on Works Orders. Smiths', carpenters', collarmakers', and telegraph mechanics' shops were situated in the stores yard, where was also a kraal for spare ponies and mules.

The next link in the chain of organization, and the most important one of all, was formed by the Inspectors. The Transvaal was divided into 10 sections, each under a senior N.C.O. as Inspector. The Inspectors were responsible for all details of the telegraph service :— the regulation of the traffic ; the control of the staff, both operating and engineering ; the repair and maintenance of lines and instruments ; the collection of office copies of messages, and of cash accounts ; estimating for and carrying out new lines ; the payment of all soldiers and civilians, except civilian operators who were paid by cheque direct from headquarters ; and the military discipline of all soldiers employed on telegraphs in their sections.

This was a great responsibility, and right well did the N.C.O.'s rise to the occasion. As examples I give the actual figures of 1st June, 1903, for the Johannesburg and Middelburg sections, selected as examples of town and country :—

	Johannesburg.	Middelburg.
Instruments working :—		
Wheatstone automatic	3	1
Quadruplex	2	—
Duplex	6	1
Simplex	27	24
Vibrators	4	2
Military telephones	84	244
Town telephones	774	—
Staff :—		
Operators—R.E.	38	30
Infantry	4	13
Civilian	50*	9
Telephone operators (civilian)...	23*	—
Messengers (civilian)	43*	6
Linemen—R.E., Sappers ...	8	19
Drivers ...	—	2
Civilian	9	—
Working parties—R.E. ...	19	4
Civilian ...	18	—
Natives ...	144	27

* The civilian staff at Johannesburg was to a certain extent controlled direct from headquarters.

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Transport :—

	Johannesburg.	Middelburg.
Native drivers	16	10
Mules	73	28
Horses	12	17

Below Inspectors, the organization divided into linemen, telegraph masters, and foremen of working parties. The linemen were each responsible for the lines in a definite section of country, the telegraph masters each for their own office and the staff of operators, and the foremen for their working parties.

As the Boers had lost all their guns, the era of blockhouse lines, in the spaces between which "drives" could be carried out by mobile columns, had set in. Five lines of railway radiate from Pretoria and Johannesburg, to the N. to Pietersburg, to the E. to Komatipoort, to the S.E. to Volksrust, to the S. to Vereeniging, and to the W. to Klerksdorp. These first were protected throughout by blockhouses, eventually at distances of about ½ mile apart, and afterwards other cross lines were run between them, and to join up with lines in the O.R.C.

The stations on the railway lines, and the defensible posts at 15 or 20-mile intervals on the veldt lines, were supplied with telegraph offices working in to some local centre. From these telegraph offices telephone lines extended in each direction, telephones being fixed in every third or fourth blockhouse—in some cases more frequently. The telephones were worked by the troops defending the blockhouse line, but maintained by the telegraph linemen. In addition to these, each town or post of any importance had a local exchange, and telephones to all the forts, posts, camps, and offices.

On the railway lines the existing poles were utilized, additional copper wires being run with permanent brackets and insulators by working parties as required. Thus three wires throughout—in many places four—were added from Pretoria to Komatipoort, a distance of nearly 300 miles.

On the veldt the practice was to run the lines simultaneously with the erection of the blockhouses, a section under an officer erecting the line, which was handed over for maintenance to the Inspector concerned when it was finished. Nearly all these veldt blockhouse lines required two wires throughout, so that the field air-line equipment was not altogether suitable. All the Mannesmann poles (poles iron, semi-permanent, Mark II.) which could be obtained were quickly used up; a great quantity of poles, wood, 15-foot (a wooden pole in two pieces), was got out from England and used; and many light 15-foot poles manufactured in South Africa were erected. The insulators were of any small pattern that could be obtained—the field

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insulator did well, but any small cup was suitable; and the wire was mostly 100 lbs. to the mile, single strand copper, purchased locally.

The supply of telephones was a great difficulty, some 1,100 field instruments being used in the Transvaal alone. The greater portion of these were what is now known as telephone sets, portable, C, Mark I., and were purchased from Messrs. Ericsson through their local agents.

Several entirely new permanent lines were run, notably 30 miles of iron poles carrying eight revolving copper wires for telephone trunk purposes, between Pretoria and Johannesburg.

As the supply of Sappers was insufficient, considerable use was made of civilian operators and linemen, especially in the towns. The later drafts of linemen consisted chiefly of hastily trained men recruited from the National Telephone Company. These men did good work, but required a considerable amount of training before they got into Army ways.

The distances were so great that practically all the country linemen had to be mounted. Fortunately the ponies in use did not require skilled horsemanship; all linemen in the field telegraph companies are now taught riding and the care of horses.

The following statistics from the official History of the Telegraph Operations will be of interest; they cover the entire period of the war:—

Total *personnel* employed	2,753
Number of telegraph offices opened	1,050
Cable, miles run	3,749
Air line, miles run	2,191
Number of words dealt with	13,500,000

The total cost, debiting pay, purchase of stores, etc., and crediting cash received from the public, value of stores handed over to P.M.G.'s, and value of messages sent for Colonial Governments, worked out at £324,000. If the cost of the telephone connections made for the Army is deducted from this at the local rates, the cost per word of telegrams sent for the Army appears at $\frac{1}{3}$ of a penny.

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COAST DEFENCE AND HOME DEFENCE.

By Bt.-Col. F. R. Reynolds, late R.E.

Within the last year several articles have appeared in this journal on the subjects of Home Defence and Coast Defence, but as the subject is one of such supreme importance to us Islanders, I will risk another article on the same subject being deemed superfluous, in the endeavour to present something which may assist towards the solution of the problem.

The importance of the subject and the pressing need for taking action, seem to me to be insufficiently expressed by the authors of the various articles, and only to have been treated from an academic point of view. Colonel Hickson's scheme surely is a counsel of perfection. Whether he advocates permanent works or not, his scheme would result in a chain of such works, whose intervals are to bristle with more or less mobile artillery, and the cost would be millions. The principle may be sound enough, but if it were proposed to spend these millions in defence works, the voice of the nation would probably say "No, we would rather have a stronger Navy."

Is there then any real necessity to do anything except keep up our naval superiority? Why is any other measure of general coast defence required? These are questions which puzzle "the man in the street," and the answers he gets from politicians and from experts are most contradictory. At one moment he is assured that not even a dinghy's crew could land on our shores, at another, that, as a bolt from the blue, some 100,000 men will gain their foothold, armed, equipped, and thoroughly organized, in spite of all that our Navy can do. However much or little we may believe in either of these extreme views, common sense and reason both warn us that we cannot expect in time of war to be free from attempts on the part of the enemy to damage our prestige and our property by raids.

In order to reckon how we now stand as regards raids, let us imagine that a state of tension exists between ourselves and another Power. Our Government does not take the steps necessary to prevent our antagonists securing an initial advantage, lest such steps should precipitate the conflict which "they still hope to avoid." The other Power means war all the time, and in the grey of the

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dawn one day, some of our undefended coast towns find themselves in the hands of the enemy. There may be no more than 100 men in one place, perhaps not more than 500 in any. Their mission is to do the greatest possible damage in the smallest possible time. From a military point of view the permanent result of this action might be *nil*, but it is impossible to realize fully the extent of damage to the nation's prestige, and the extent of confusion and loss in business circles these little raids might effect, as well as the amount of initial advantage they might thus confer on our adversary.

As regards their local effect also, would or could the inhabitants offer any resistance, or even know in what way they might minimize the result of the raid? No! All they would do would be to spread the alarming news, and exaggerate it; to inoculate their immediate neighbours and the whole country with their own panic, probably hindering any troops who might come to their assistance. The inhabitants of these places, though far outnumbering their raiders, would be useless at such a crisis.

Some scheme of coast defence therefore, as well as of home defence, would seem to be necessary, so that this danger may be obviated.

Self-preservation being the first instinct of human nature, and the British character having this prominent feature, that it prefers both work and play with something of sport in it, we have to first persuade the men we want that, for their own preservation and for that of their wives, families, and property, an efficient home defence force is a vital and pressing necessity, and we have then to devise a scheme for making the training of that force such as to appeal strongly to the sporting side of the British character.

At this point it will be useful to re-state some of the points *as to defence against raids*, which have been brought forward in previous articles, and as to which there is not likely to be disagreement.

Capt. Slade, R.N., in a lecture on "Strategy in Relation to Coast Defence," said:—

(*a*). Disembarkation should never be allowed to take place unopposed.

(*b*). A small number of men properly placed, are sufficient to make a raid a work of very great difficulty and danger.

(*c*). The proper time to deal with such expeditions is when the enemy's men are crowded together in small boats approaching the shore.

(*d*). Sufficient fixed defences are required to delay raids until reinforcements can come up to deal with them.

(*e*). It will be too late to get the men to their stations if we wait until the ships are sighted. Within an hour of that time it would be quite possible for a covering force to land.

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Colonel Hickson says in addition :—

(*f*). A land attack on a defended port should be made impossible.

(*g*). The enemy must not be permitted to land.

(*h*). Whatever our system of defence, it is neither guns nor ships nor machines of any sort which in the end decide the fate of nations ; it is the training of the men.

Capt. Slade in his lecture referred to large shipping centres, manufacturing or shipbuilding towns on the coast, wireless telegraph stations, and naval bases as liable or more particularly liable to raids ; but, as I have mentioned above, a raid might be attempted on other parts of the coast, not so much with the object of doing serious military damage, as of influencing the political situation through the agency of the nerves of "the man in the street." It would seem somewhat unwise therefore to confine our defensive preparations wholly to such places as obviously invite raids, if our resources allow us to make our coasts generally uninviting.

Fortunately our coasts are on the whole populous, and the more populous where the objective is more attractive ; so that anywhere and everywhere they might be required, there is to hand the "small number of men" mentioned in (*b*) above. All that remains to be done is to induce these men to be trained, to see that they are properly and sufficiently trained, and to ensure that when the time comes they are "properly placed."

Capt. Slade's dictum, that it will be too late to place the men in position if we wait until the ships are sighted, is extremely important, as a considerable time would be occupied in the processes of conveying the intelligence from the look-outs to the O.C. troops in the neighbourhood, issuing the necessary orders, assembling the men, marching with due military precautions to the threatened point, and taking up positions to resist the landing. We need not perhaps take Capt. Slade too literally. To have all the troops, which we allotted to the defence of our shores, in time of emergency lying in wait always for the enemy's attack, would be preposterous, but it should not be impossible to strike a happy mean between being always unready and always too completely ready.

"A small number of men properly placed" would appear to be the clue to the solution of the problem. In Colonel Hickson's view the proper place is behind artillery, in many cases behind artillery of such calibre as to necessitate fixed and practically permanent works. He says, "*200 artillerymen behind guns well placed on the coast on the flank of a defended harbour, are equivalent to something like an inland garrison of from 1,000 to 2,000 men manning guns on its land fronts.*" This may be agreed to for the special purpose he is considering, but it should not be accepted too hastily as being right for

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general application. The curse of fixed defence works is that they render so many men immobile, and coast defence works render immobile not only those manning the guns, but about an equal number of infantrymen to secure the guns themselves from surprise attacks. There these men are, and, being allotted to these somewhat costly works, there they will remain, however urgently they may be required at some other point on the coast. So it may be said without exaggeration that *for general purposes of coast defence 200 men free to move are worth 1,000 men tied to fixed defences.*

I do not wish to combat the view that guns and works are desirable on the coastal flanks of our defended ports, but I wish to insist that, as these works require infantry to protect them against raids, the natural inference is that infantry, rather than artillery, is the arm on which we must depend, in the main, for general coast defence.

Having got thus far, it will be desirable now to consider what sort of training is required for our coast defence infantry.

A fully-trained soldier must have a knowledge of a wide range of subjects, but the end of all his training is evidently to make him fitter than his possible opponent, to plant bullets in the desired spot at the desired time. The reason that the soldier requires so wide a training is so that he may fulfil his mission anywhere all over the world, under circumstances perhaps of great difficulty and danger, which would soon render a poorly-trained man *hors de combat.*

The men whose training we are considering however are more fortunately circumstanced, more fortunately both for themselves and for their country. All that would be required of these men is that, when the time comes, they should line their native and familiar shore, and plant bullets into the approaching enemy. They would live most of the time in their own homes, be tended when sick or wounded by their own people, should have at their fingers' ends a knowledge of the defensive capabilities of their coast, and of all the natural or artificial aids to picking up ranges, and they would know that, if attacked, they had only to hold on for reinforcements to come to their assistance from all sides. It is evident that in this case the advantage of the defence over the attack is so great, that the fully-trained soldier of the attack (and that he would be not only fully trained but picked there is no doubt) could be resisted successfully by a much less fully-trained defender.

In an army all hands require general training as soldiers, but in addition they require special training for the particular branch of the army to which they may belong. Where men can devote only a small part of their time to military work, it is a question whether much more than the special training can be attempted. The case of the Volunteer Submarine Miners was one in point. These were men selected for their knowledge of electrical work or boatwork, and trained for little else than their special duties as submarine miners.

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The result was most successful, but had these men been required to undergo a lot of general military training, as well as their special training, they would have fallen between two stools.

It seems to me therefore that when one speaks of the "less fully-trained defender," it does not follow that it means he need be less trained in regard to some particular branch of military knowledge. Our object should be, in fact, to give him as good, or better training, than his possible opponent is likely to possess, in the particular branch which is most likely to be useful—in this case evidently in musketry.

The unfortunate enemy, once he has quitted his transports to make the attempt in small boats to reach the shore, can make use of none of his training, and during this transition period any men on shore with rifles would have an advantage over him. One of our axioms however is that the enemy must not be allowed to land. To prevent a determined enemy from landing, will necessitate not merely that he should be made very uncomfortable in his approach to the shore, but that he should be absolutely demoralized by his losses. If we would make sure of achieving this result, our men on shore must be experts at firing at marks floating on the sea, and not only should their fire be deadly at medium ranges, but it should begin to be terribly effective at the maximum range of their rifles.

Now firing at a mark floating on the sea differs from firing at one placed on land, because the sea forms a more or less luminous background, against which the floating object appears with much greater distinctness than would an object at the same distance on land. The result of this distinctness is that ranges over sea are very much underestimated by those unaccustomed to judging them. Another result of course is that the object is more easy to aim at than if at the same range on land, the absence of any obstacles to direct vision, except possibly waves to some extent, contributing to the ease of aiming. A dinghy seen at the extreme range of the rifle is a prominent object, and the much larger boats used for the attempted landing would provide very satisfactory marks for our expert coast defenders, from the moment they came within range. Wave motion, on the other hand, is against accurate marksmanship to those who have not studied it. All this points to the conclusion that our coast defenders must be trained not on land ranges but on sea ranges.

Seeing how increasingly difficult the provision of land ranges is becoming, the fact that for the purpose under consideration sea ranges are best, is a fortunate one for us. Possibly many will doubt whether ranges over sea with floating targets can be devised in a form suitable to give the required training, but there would appear to be no inherent difficulty in devising means whereby the result of a man's shot at a floating target should be made known to him, and this is all that is essential for a commencement. A target which apparently signals electrically each hit made as well as its

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position, has just been invented and is about to be manufactured. Space for ranges is practically unlimited, although at popular seaside resorts it might be necessary to suspend practice at certain seasons. Boats, which had completed their useful life in the Navy, instead of being sold as scrap iron might be patched up and used as target platforms. Some of these boats could have their engines left in, and could tow other boats containing dummies to represent a raid, moving round the coast so as to afford tactical exercises periodically to the different sections. Nor is it intended that these men should have no training beyond musketry; some drill is naturally necessary, as a sense of discipline must be imbued.

The main thing to be borne in mind would be that the training of these men, instead of being directed towards fitting them for universal service, would be concerned only with the single and definite purpose of making them coast defenders. Such a course has several advantages; first of all it enables the men who are willing to devote some of their leisure to the purpose, to make themselves really effective for the defence of their country. It cannot be gainsaid that the volunteer has proved his ability to become an expert shot, if he is given opportunity of sufficient practice. Also there is no reason to suppose that the fascination of rifle shooting would be less over a sea range than on a land range; in fact, it seems probable that the greater realism, which possibly might be evolved on sea ranges, would add a zest to the pastime.

It is evident that in case of our being involved in war with a power of any naval pretensions, we should either acquire gradually or lose gradually the command of the sea. We could not hope to gain it immediately, though we should hope not to be too long about it; we certainly should expect that it would be a very long time before we lost it. This period of naval activity would also be the period of raids, which, as mentioned above, are liable to give rise to nervous clamours very unwelcome at such a time. Can anything be imagined as more likely to be effectual in nipping raids in the bud, than the knowledge that behind our fleet was a body of troops specially trained to deal with them, deadly accurate as shots, and ready as well as eager to meet the enemy at any point he liked to select?

Given such an outpost line as this, the six months training of the rest of the Territorial Army could proceed without fear of disturbance. The scheme for this outpost line being based on the instinct of self-preservation, should appeal powerfully to our coast-dwellers if it were put before them properly; consequently one would expect it to be successful as regards obtaining the numbers required. The training need involve but little military formality, a thing abhorrent to many civilians. The rifle practice would prove more interesting than that on land ranges, owing partly to the ever-changing conditions of light and movement in the sea, and partly

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to facility for movement on the sea, rendering changes in tactical conditions easy to devise. For these reasons one would expect the force to become efficient with only the training which could be given in the spare time of its members, although it would be desirable that these outpost troops should participate as far as possible in the six months general training of the Territorial Army.

I have dealt now with all the points referred to in (*a*) to (*h*) above, except (*d*), to which I will refer presently. Here I will recapitulate briefly, to show that the scheme, besides being based on strong human instinct, and being suitable to British character, is also logical.

The Territorial Army must have six months training after mobilization to make it fit to take the field; to ensure the possibility of giving this training our coasts must be strongly defended. Such strong defence is only possible by having troops on the spot and specially trained for it. This special training will be very popular, and can be given in the leisure hours of the men who are available, and who live on the coast.

At (*d*) above, fixed defences are mentioned. As to these one cannot say much, except that they must be thought out for each locality, be suitable for the number of men available, and that they should be of as simple and easily constructed a character as possible. Fixed defences in the shape of batteries for artillery of heavy calibre, I would deprecate as a general rule, but I would not wish it to be understood that I do not appreciate the benefits which artillery is likely to confer on the defence. I believe that there would be plenty of men available for all arms, but I would like first to make sure of having plenty of infantry, and from that basis to evolve the whole force required. As far as possible (and a good deal is possible in these days of motor traction and our good roads) the artillery should be mobile.

Finally, to deal with some of the objections which will be brought against this scheme.

First it will probably be said that I am making the fatal military mistake of trying to be strong everywhere. There is a vast difference between *being* strong and *trying to be* strong. All I am proposing to do is to take advantage of the strength which exists everywhere along our coasts, but so far has not been sufficiently utilized.

Again it may be urged that the proper way to make use of this strength, is to collect the men available into strong bodies which can be brought to bear decisively against the enemy, as soon as it is known at what point his attack is to be developed. It seems to me however that it would be folly, when we can keep the men in their own homes, to collect them in camps at some distance from the shore. This would give the enemy, who has the initiative, the choice of route and the superiority of speed, the opportunity he requires, as

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he could cause the collected body of troops to move in the wrong direction by means of a feint. If on the contrary our coast outposts remain in their own homes, they will be strong enough everywhere to delay the enemy's landing, there will be no chance of mistaking a feint for a real attack, and against the real attack an ever-increasing number of defenders will rapidly arrive by motor, cycle or train.

To deal with one more objection; it may be urged that if this force is only an outpost force, why have it so strong. Outposts on a land front are kept as weak as possible, owing to the hardship and fatigue of the work which exhausts the troops employed on the duty; but in case of real necessity there is no hesitation in increasing their strength. Again, in the case of land-front outposts the enemy's speed of advance is slow, and his route is usually confined to certain tracks; consequently the cavalry and infantry patrols in front of the line of observation should generally discover his advance in time to alarm the whole outpost force. Our coast outposts would face the sea, over which the raid-conveying ships would move with great rapidity and in any direction. They would have a good chance therefore of escaping the observation of our sea patrols (the fleet), and of appearing at any point they might select without being seen by any on shore but those within a few miles of the point attacked. Hence arises the necessity for the coast outposts to be stronger in proportion to the extent of front covered than ordinary outposts usually are. As the men would live in their own homes, the hardships and fatigues of the work would be reduced to a minimum, and altogether it would not appear that the objection to having a large force employed on outpost duty holds good in this special case.

The case of defending a coastal frontier differs in many important particulars from that of the defence of a land frontier, and in consequence requires special measures, which may seem to differ from accepted military principles. The scheme I have proposed above has, I hope, the merit of being logical and based on common sense; also of being effective not only against raids, but as far as any scheme of land defence can be effective, against invasion also.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—DUBLIN, 1908.

EXTRACTS FROM THE ADDRESS TO THE GEOGRAPHICAL SECTION BY MAJOR E. H. HILLS, C.M.G., LATE R.E., PRESIDENT OF THE SECTION.

THE 30 years that have elapsed since the British Association last met in this city of Dublin have seen an obvious and rapid progress in the science of geography, and a steady though perhaps not quite so apparent a change in the character of that science.

In 1878 large parts of the earth's surface still remained untrodden by the feet of a white man ; large areas were open to the enterprise and intrepidity of the explorer ; large spaces were blank paper upon our maps. Now there is but little of the earth's surface absolutely unknown.

It is not my intention to detain you by any recapitulation of the work of these years to show you how and by whom these areas have been traversed and the gaps in our maps filled in. I intend rather to speak of the present and of the future work of the geographer, and to do this to any advantage we must at the outset recognize the change that has taken place in the nature of his task, and the fact that the days of individual exploration are over, never to return. We must recognize that sporadic, unorganized effort must be and is being replaced by organized work, and that the scientific traveller of the last century, with his rough map-making equipment, his compass, watch, and sextant, has yielded his place to the scientifically equipped survey party with their steel tapes, theodolites, and plane tables. * * *

I am not ambitious enough to attempt to cover the whole surface of the earth in the brief review that I intend to put before you of the progress of scientific survey. Rather I wish to restrict our outlook to that section of the work in which we may all be considered as having a direct personal interest—namely, the survey of the British Empire, especially those lands under the more immediate tutelage of the Government of this country. Let it not be thought however that while we for the moment pay little attention to the regions lying outside this definition, we are supporting the fallacious idea that the survey of any part of the earth can be considered apart from the survey of the surrounding country. With the possible exception of the case of an oceanic island, such an assumption would be an erroneous one. Our British Empire is so widespread and our

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possessions are so often in close and intricate juxtaposition with those of other nations, that there is in this work large scope, and indeed necessity, for international co-operation. * * *

Before proceeding to the consideration of our special subject, the survey of the British Empire, it will be interesting to interpose a few remarks on the questions of the utility and origin of national surveys in general. We may first note the somewhat curious fact that the production of a map of a country, useful as such a work is for many purposes, has almost always been embarked upon because the imperative necessity of maps of the theatre of operations in war has been brought home to the people and Government of a nation. Thus the ordnance survey of England had its first beginning in a military map of the highlands of Scotland, commenced in 1747, intended to facilitate the operations of the troops under the command of the Duke of Cumberland. * * *

In the case of our other great national survey, that of India, its origin is to be found in circumstances somewhat analogous. The Madras Government, owing to the success of the British arms in the Mysore Campaign, found itself with a great accession of totally unsurveyed country in the middle of the Peninsula, while at the same time there were only in existence the roughest sketch-maps of the older possessions. It was apparent that if any map, of even approximate accuracy, was to be made covering a country of such vast area, it was imperative that the work should be prosecuted upon the most rigorous and strictly scientific basis. The general lines upon which it should be undertaken were laid down in February, 1800, by Brigade-Major Lambton, who addressed a letter to the Madras Government advocating a mathematical and geographical survey of the peninsula. * * *

In this short recital of the determining causes which have in the past led to the initiation of national surveys it will have been noticed that no allusion has been made to what we should now perhaps consider the main utility of a map—namely, its value for all purposes connected with the ownership, development, and taxation of land. * * *

Neither were any of the early surveys undertaken for the purpose of mutual delimitation of international boundaries, a necessity which has in recent years been the stimulating cause for many pieces of valuable survey work, especially in Africa.

Let me now turn to the main subject of this address—the enquiry as to how far the duty of adequate mapping of our territories is performed by us, what shortcomings we can perceive, and what suggestions we can offer for the future.

Two years ago this task would have been a difficult and laborious one. Now it is greatly facilitated by the issue from the Colonial Office of those excellent little volumes, the reports of the Colonial Survey Committee.

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This body has been in existence since August, 1905, and has published three annual reports. The Committee is therein defined as an advisory one formed at the instance of the Secretary of State for the Colonies to advise him in matters affecting the survey and exploration of British colonies and protectorates, more especially those in tropical Africa. It is not at present an executive body, that is to say it has at its own disposal no grant of public money or other funds; whether it will ultimately develop into such is a question that the future alone can answer. Even thus limited in scope and powers it has however already worked a notable improvement—firstly, by laying down authoritatively some of the more salient conditions that ensure the efficient and economical expenditure of whatever funds may be available, and by pointing out the disastrous extravagance of unsystematic and unmethodical work; secondly, by insisting upon uniformity where uniformity is essential, such as in matters relating to the style, projection, scales, and sheet-lines of the maps produced, while leaving the utmost latitude as to methods, these being selected in each case to suit the very divergent nature of the country met with. It results from this that any two small portions of the map of Africa, say, for instance, one sheet of the dense forest region of the Gold Coast and another of highland country of East Africa, though 3,000 miles apart and executed at different times by a different staff, will match each other in general character, and will ultimately be found to fit exactly into their places as constituent parts of a great map of the country; thirdly, we may reckon the mere fact of publicity in these matters as of no mean advantage. Though, as in the case of many other Government publications, this report is not as widely read as its merits deserve, yet it is all to the good that the information is there ready and available for anybody who has the curiosity to consult it. I therefore welcome the opportunity of drawing your attention to this volume.

In entering upon the discussion on the survey of British Africa, the first point that meets us is the geodetic basis of the whole work; upon what do the actual positions depend? In other words, to put the matter more familiarly, how are we to provide that every isolated piece of the map will exactly fit into its proper place? The only method for ensuring this is by basing all our surveys, ultimately, upon a skeleton or framework of geodetic or primary triangulation executed with the utmost attainable precision. Such a skeleton, or rather backbone, will eventually exist in Africa in the shape of the meridional arc, or chain of triangles, along the 30th meridian, running right through the country from north to south, and ultimately joining on to the great arc observed by the famous astronomer Struve. This originally extended from the mouth of the Danube to Hammerfest, in Norway, an amplitude of $25\frac{1}{2}^{\circ}$ of latitude. To prolong it southward, passing up the Nile Valley, through the heart of tropical Africa,

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across the Zambezi River, and terminate it at the southernmost point of the continent, is a magnificent conception due to Sir David Gill, to whose energy and enterprise the actual execution of considerable sections of the undertaking must also be ascribed.

At the present time the chain has been completed from the south to within 70 miles of the southern end of Lake Tanganyika, a distance of about 1,700 miles. At Lake Tanganyika it will enter into German territory. The German Government, fully recognizing that the project is not only of great theoretical interest, but also of immediate practical value, are already taking steps to start work on their own section, from the south of Tanganyika up to the parallel of 1° south latitude. From 1° south, northward to about 1½° north, the arc lies near the boundary between the Congo Free State and the British Protectorate of Uganda. An International Commission is at present engaged in the survey of the boundary region, and Sir D. Gill,* ever ready to seize an opportunity of forwarding the work he has at heart, succeeded in raising sufficient funds, partly from the Treasury and partly by grants from a few leading scientific societies, to enable an observer to be sent out with this Commission to carry the arc over this section. North of this point the line comes into the territory of the British Soudan, and traversing this, eventually reaches Egypt proper. Here it comes into the charge of Capt. H. G. Lyons, the director of the Survey Department of Egypt, under whose care its interests are safe. * * *

With regard to the section joining Africa and Europe the position is not so happy. This will run through Palestine and Asia Minor, and therefore lies in Turkish territory. It is not likely that the Turkish authorities either will or could carry out such a work; in fact, seeing that even when completed it would be totally useless to them, it would be hardly reasonable to expect them to do so. It must therefore presumably be a matter for international co-operation. * * *

When we look back a few years and call to mind the prominent part that this country has taken in the survey of Palestine— I need only mention in this connection the names of Kitchener, Warren, and Conder—we cannot avoid a feeling of regret that we are not ourselves in a position to take the whole execution of this section of the line upon our shoulders. I am too well aware of the many urgent claims upon the Treasury to suggest that it is possible that they would be prepared to incur such a charge; but supposing, for the moment, that part of the necessary funds could be provided from other sources, I think we may fairly urge that it is our duty to contribute a substantial monetary grant towards the furtherance of an end so desirable and so practically useful. * * *

* *Note by Editor.*—This was, as a fact, undertaken at the suggestion of the Secretary of State for the Colonies.

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If we take the map of Africa we shall see that the arc along the 30th meridian passes through, or near, all the colonies of British South Africa, close to British Central Africa, or Nyasaland, through Uganda, and is thus connected with British East Africa, through the British Soudan and through Egypt. There remain absolutely untouched by it only the West Africa colonies—Nigeria, the Gold Coast, Sierra Leone, and the Gambia. These latter will eventually get their geodetic framework by an extension southwards of the French triangulation of Algeria, a work of a high order of precision. We are therefore entitled to say—and I take this opportunity of saying it with all due emphasis—that with the exception of some triangulation to join the West African colonies with the French triangulation, the arc along the 30th meridian is the only primary triangulation required for the adequate mapping of the whole of British Africa. The remainder of the geodetic framework can be supplied by ribs of secondary triangulation branching out from the main backbone, such as the line already completed along the boundary between British and German East Africa, passing to the north of the Victoria Nyanza and thence westward to the 30th meridian. * * * You will observe that I here speak only of the triangulation required for mapping purposes, not of that demanded by the geodesist for the study of the figure of the earth. It cannot be other than a very long period before the whole of Africa is surveyed upon such a scale of accuracy, and in the meantime we must devote ourselves to the far more urgent duty of mapping the country, leaving the more remote and abstract task to our descendants, well satisfied if in our hands the foundations have been well and truly laid. * * *

Having thus passed in brief review the ultimate geodetic basis of our African surveys, let us enter more into detail and glance at the actual survey work now in progress in the different regions of the continent.

In British South Africa, as we have already noted, the political conditions are at present unfavourable to any comprehensive scheme of operations. There is however in progress a first-class topographical survey of the Orange River Colony and a reconnaissance survey of Cape Colony. The former is an excellent example of the class of work that can be done by a small military party of the highest technical training working upon systematic lines, and I should like to devote a few minutes to a short description of the methods adopted and of the results obtained.

The survey party consists of two Royal Engineer officers and four non-commissioned officers, the former undertaking the triangulation and the general supervision of the field work, and the latter the plane tabling. The positions are primarily based upon the points of the geodetic survey broken up into a secondary triangulation, with sides averaging 10 miles. In 1907 the average triangular error of the

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secondary work was 2·9 seconds of arc, and the greatest linear errors of displacement, as tested by the geodetic triangulation at the end of a chain 45 miles long, were 3 feet in latitude and 2 feet in longitude. The probable error of a trigonometrical height was under a foot. You will see therefore that the accuracy is ample for all mapping purposes, even upon large scales, and the degree of precision is in excess of that demanded for a topographical map on the scale of 2 miles to an inch. The rate of progress and the low cost of work are however no less notable than its accuracy. The actual rate of out-turn is about 8 square miles per day per man, or for the whole party 23 square miles of detail survey per diem, and the number of trigonometrical points fixed about 300 per annum. The cost works out to about 8s. per square mile of the completed map, and the whole area of 47,000 square miles will be finished, printed and published, in $5\frac{1}{2}$ years.

These remarkable results are due in a large measure to the energy and organizing power of the officer in charge, Capt. L. C. Jackson, R.E. The detail survey is done in sheets 15 minutes square, each non-commissioned officer being given one complete sheet, which he works at until finished. Four such sheets are therefore in progress at any given time, and each sheet takes about six weeks. Seeing the rapid rate of progress maintained, it might perhaps be thought that the country is a particularly easy one for the topographer. Such is however by no means the case. It is true that there is an entire absence of the surveyor's greatest impediment, large areas of dense forest, but there is much broken and difficult country, rising in places to altitudes of above 7,000 feet.

In Cape Colony the reconnaissance survey is of a somewhat similar character, but owing to the large area of the country and to the small amount of money available the work has perforce to be of a more rapid nature. In Natal, Bechuanaland, and Rhodesia no survey is at present in progress.

Passing northward through Africa, we come to the British Protectorate of Nyasaland, formerly called British Central Africa. Of this country a certain number of maps exist purporting to give topographical detail; but as they are not based upon any framework of triangulation, and as much of the detail only depends upon rough sketches, it is impossible to say how far they can be accepted as correct representations of the ground.

It is most unfortunate that financial considerations prevent the execution of any systematic trigonometrical survey. The absence of such, and the fact that maps are being made which must inevitably be withdrawn and replaced by others in the future, will undoubtedly be the cause of ultimate waste of money.

Passing northward again, we come to the large and important protectorates of British East Africa and Uganda, in both of which

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systematic surveys are in hand. The geodetic framework is supplied by a triangulation along the Anglo-German boundary, connected with chains of triangles along the railway in the neighbourhood of Nairobi. In Uganda proper there is also a triangulation covering a substantial area. As already noted, all this work will eventually be tied into the 30th meridional arc, though it is not likely that the final adjustment of geodetic positions thus arrived at will necessitate any substantial alterations upon the maps.

In both protectorates topographical surveys are in hand, and maps on the scale of 2 miles to an inch will be issued. In British East Africa, under the able direction of Major G. E. Smith, R.E., rapid progress is being made. This topographical mapping is additional to the cadastral maps also in progress in both countries. These latter are required for property purposes, in Uganda for demarcating the estates given over to the native inhabitants of the country under the agreement of 1900, and in East Africa for attachment to title-deeds of lands alienated for farming or stock-raising.

In the Soudan the enormous area of the country—over a million square miles—and the limited funds available have prevented any systematic survey being taken up. A large amount of reconnaissance mapping has been done, and a series of sheets on the scale of 1/250,000 (4 miles to an inch) have been published. These are corrected and improved by officers and Government officials as opportunity offers. The energies of the Survey Department* are almost entirely spent in meeting urgent local requirements in the shape of cadastral maps of the cultivated areas along the river.

Somaliland, a British protectorate which came into unfortunate prominence a few years ago, is a country of too small value to be worth the cost of any sort of survey, and the only maps that exist are based upon the route sketches of travellers and sportsmen, and upon the work done by a small section of the Survey Department of India during the military operations five years ago.

Leaving the east side of Africa, and turning our eyes westward, we may note that in the colony of the Gold Coast a rigorous survey was rendered imperative by the gold-mining boom of 1901. The work was entrusted to Lieut.-Colonel Watherston, C.M.G., R.E. Owing to the dense forest covering practically the whole country, triangulation would have been prohibitive in price and very slow in execution. The initial positions were therefore fixed by a network of long traverses, executed with all possible refinements with steel tapes and theodolites. Astronomical latitudes were observed by Talcott's method at every 50 miles. The errors of misclosure of the traverses proved to vary from about 1 in 2,000 in unfavourable cases to nearly 1 in 6,000—results inferior to triangulation, but at the same time sufficiently accurate to form the basis of a map with no appreciable

* Under Capt. Pearson, R.E.

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errors *on the paper*. One great defect of the traverse method of fixing points lies in the practical impossibility of carrying the heights through without occasional checking, either by lines of levels or by trigonometrical observations. Such work makes therefore an imperfect basis for topography, and would only be used when natural features compel its adoption.

Northern Nigeria is a country of enormous area, and, up to the present, of small revenue. It has therefore not been found possible to allocate the funds for any systematic mapping. The existing maps are compilations based upon sketches made by civil and military officers when travelling upon duty, and upon the surveys made by the different Anglo-French and Anglo-German Boundary Commissions. In 1905–6 Capt. R. Ommanney, R.E., fixed the astronomical longitudes of 15 towns by exchange of telegraphic signals with Lagos. With the aid of these values, combined with a number of astronomical latitudes, it has been possible to combine the material into something like a complete map. It need however hardly be pointed out that astronomical fixations are liable to large and uncertain errors, due to the variation of local attraction, and cannot attain the precision of even a rapid triangulation. In Southern Nigeria the experience has been somewhat unfortunate. This colony has spent a very substantial sum upon its survey department, and if the work had been properly organized and systematically carried out we should by now be in possession of a complete map of a large portion of the country. Unluckily, the mistake has been made of detaching survey parties for non-geographical purposes, such as the erection of telegraph lines, work doubtless urgently required in the interests of the colony, but not lying within the sphere of a survey department. Thus systematic progress was rendered impossible, and though isolated pieces of triangulation and long lengths of traverses have been done, no topographical map of any area yet exists.

Of the remaining West African colonies, the Gambia River is a narrow piece of land with boundaries running parallel to the river banks, and, except for the actual trade along the river, is unimportant. In Sierra Leone the country in the immediate vicinity of Freetown was surveyed by the Colonial Survey Section, a small party employed by the War Office for the purpose of making surveys of places of special military importance. The map of the remainder of the colony is a compilation based on miscellaneous material.

In the course of this summary of the state of the mapping of British Africa mention has been made of the surveys made by joint commissions appointed for the delimitation of international frontiers. No small part of the existing map is due to work of this class. Thus joint Anglo-French Commissions have marked out the frontiers of the Gambia, Sierra Leone, the Gold Coast, and Nigeria; Anglo-German Commissions, the eastern boundary of Nigeria, the boundaries between

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British and German East Africa, between German East Africa and North-East Rhodesia from Lake Nyasa to Tanganyika, and between Bechuanaland and German South-West Africa; Anglo-Portuguese Commissions, the frontiers between Portuguese East Africa and North-East Rhodesia and Nyasaland respectively. Useful surveys have also been made in the course of the mutual demarcation of the frontiers between Abyssinia and the Soudan on the west and British East Africa on the south; also of the frontier between the colony of Sierra Leone and the Republic of Liberia.

Important as the work done by these Commissions has been, its value would be greatly enhanced if the reports of each Commission were published in a succinct and easily accessible form. Such reports would naturally contain a record of the actual frontier as finally ratified, and also a technical account of the survey methods employed. They would thus be of permanent use both to the official or officer on the spot for the easy settlement of any disputes that may arise, and to the chief of any future boundary commission as an aid to the selection of the methods of survey most suitable to the particular country with which he is concerned.

Up to three years ago many of the African protectorates were under the tutelage of the Foreign Office, while the older colonies were under the Colonial Office. The reports of Boundary Commissions are therefore scattered through official documents in the two offices, and are drawn up upon no uniform model. Now that the superintendence of all these territories has been handed over to the Colonial Office, and that body has set itself such an excellent example in the appointment of the Colonial Survey Committee and the publication of its reports, it is greatly to be hoped that they will follow up the good work and systematize and publish all these Boundary Commission reports. If a model for such a publication is desired, I may refer to the account of the demarcation of the Turko-Egyptian frontier between Rabah on the Mediterranean to the Gulf of Akaba, lately issued by the Egyptian survey. * * *

The geographical survey of the British Empire, apart from Africa, will not on this occasion detain us long. I exclude from present consideration the great self-governing colonies—Canada, Australia, and New Zealand—and also the whole country lying within the sphere of the Survey of India. Ceylon has an elaborate land survey system; and though, owing to past mistakes, the geographical mapping of the island is in a most lamentably backward condition, there are good grounds for hope that this state of affairs will be remedied in the near future. The Malay States, where, owing to the fertility of the soil and the ubiquity of rich tin ore, the land values are high, have the basis of an excellent survey system, and possess a backbone of triangulation which will eventually extend southward to Singapore, and possibly northward to join the Indian series in the south of Burma. Hong Kong, including the leased territory on the

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mainland, is of small area and of no appreciable geographical importance. It has been adequately mapped for military purposes. Of our insular possessions, Mauritius, St. Helena, and (in the Mediterranean) Cyprus and Malta, are thoroughly surveyed. The other islands scattered throughout the ocean which fly the Union Jack, including the West Indies, while their coast lines have naturally been the subject of close attention by the Hydrographic Department of the Admiralty, are, as regards their internal geographical features, still quite imperfectly known. The large and important territory of British Guiana is entirely unsurveyed, and indeed in part almost unexplored.

You will thus realize that if we are prepared to admit the validity of the premiss that the mapping of its own territory is an imperative duty of a State which aspires to justify itself before the nations as the possessor of a world-wide Empire, there is still plenty of employment for the scientific geographer in the British dominions. * * *

In concluding this address I feel constrained to apologize for what may have appeared to some of you the dull and unromantic character of my theme. I am too well aware that to many the idea of geographical advance is confined to the perilous traversing of virgin lands, to the navigation of unknown waters, and to the penetration of forests or deserts never yet trod by white men's feet. I am conscious that the substitution of the surveyor for the explorer has necessarily destroyed much of the old romance, and that the feelings born when any fraction of the earth's surface was for the first time opened to our ken can never be revived. While however the romance has gone, the dangers remain, and there is as much call now for unflinching courage and for unselfish devotion to duty as there was in the days when the search for the sources of the Nile was an impelling cause sending adventurous men into the unknown. Whether occupied in cutting his way through the almost impenetrable forests of the Gold Coast or struggling with the papyrus swamps of the Nile basin, or whether, standing upon the top of some old volcanic hill, he is engaged in scanning the blue distances of the great Rift Valley, the surveyor is not less worthy of your admiration than the earlier traveller whose name is perhaps honourably enshrined in that of river or mountain. Whether pushing his way through the jungles of the Malays or floating upon the muddy stream of an African river, whether he is braving the attacks of savage animals, of treacherous natives, or the far more insidious assaults of the germs of some deadly disease, he is equally deserving of your sympathy and your encouragement. He is in truth a shining example of the power of that spirit of adventure and thirst for information which has carried our race so far in the past, and which in the future is, we all trust, destined to lead us ever "upwards and on"; the spirit that esteems no sacrifice too great in the cause of duty, and recognizes no duty so high as that of making some contribution towards the increase of natural knowledge.

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THE R.E. HEADQUARTER MESS.

(*Continued*).

By LIEUT.-COLONEL B. R. WARD, R.E.

The main portion of the collection of pictures and busts in the Headquarter Mess is located in the Mess Room itself.

At the east end of the room is an impressive portrait of His Majesty the King, painted by Mr. H. Macbeth-Raeburn after the State portrait by Luke Fildes.

In 1904, on the death of H.R.H. the Duke of Cambridge, His Majesty paid the Corps the very great honour of becoming its Colonel-in-Chief in his stead. The announcement was made in the *London Gazette* of the 2nd May, 1904, and reads as follows:—"The King has been pleased to confer upon the Royal Regiment of Artillery and the Corps of Royal Engineers the honour of becoming their Colonel-in-Chief.—Dated 1st May, 1904."

Consequent on this announcement, it was decided at the Annual Corps Meeting of 1904, to commemorate this honour by procuring for the Mess a portrait of His Majesty. Sir R. Harrison interviewed Sir Luke Fildes, and obtained permission from him for Mr. Macbeth-Raeburn to make a copy of his famous State portrait.

The picture is flanked on the north side by one of George Augustus Eliott—Lord Heathfield—and on the south side by a magnificent portrait of Lord Napier of Magdala.

Lord Heathfield's picture is an excellent copy, made by Miss Kate Morgan, of one of Sir Joshua Reynolds' most famous portraits in the National Gallery. It was presented to the Mess in 1877 by Lieut. C. M. Watson, R.E., and represents Lord Heathfield as holding a key, commemorative of his defence of Gibraltar against the combined French and Spanish forces from 1779 to 1783.

Lord Heathfield's connection with the Corps dates from his appointment as Practitioner Engineer in 1741 to his resignation of his Engineer's Warrant in 1756. It was not until 1757 that military rank was granted to the Corps of Engineers, Lord Heathfield having in the meantime risen by means of steps in the Royal Artillery and Horse Grenadier Guards to the rank of colonel. His services in the War of the Austrian Succession from 1742 to 1748, where he was present at Dettingen and Fontenoy, and his brilliant career at the head of his light cavalry regiment (named after him Eliott's Light Horse, now the 15th Hussars) in the Seven Years' War (1756—1763), were eclipsed by his conduct of the famous

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defence of Gibraltar from 1779 to 1783. At the conclusion of peace he was made a Knight of the Bath, and was raised to the peerage in 1787 as Baron Heathfield of Gibraltar. He died at Aix-la-Chapelle in 1790.

The portrait of Lord Napier is by Lowes Dickenson, and is one of the best original portraits in the Mess. Technically it is a fine piece of work, the face especially being full of character. It represents Lord Napier, in the uniform of a Field Marshal, holding in his hands a bunch of keys, indicative of his office as Constable of the Tower.

The chief portraits in the north annexe of the Mess Room are those of Sir Charles Pasley, Sir John Burgoyne, and Sir William Denison.

Sir Charles Pasley and Sir John Burgoyne both obtained their first commissions in 1798, the former being the senior by some five months. Sir Charles Pasley is best known by his work as founder of the R.E. Establishment in 1812, and as its Director for nearly 30 years. His work in connection with this Establishment has been fully dealt with in the February and March, 1908, numbers of the *R.E. Journal*, and full details of his life will also be found in the *R.E. Professional Papers*, New Series, Vol. XII., *The Dictionary of National Biography*, and Porter's *History of the Corps*.

Sir John Burgoyne is endeared to all R.E. officers beyond any other name in their history, on account of his great services to the Corps during his unprecedented service of 70 years.

It was not until 1868 that he resigned the office of Inspector-General of Fortifications, at the age of 86, and his statue by Boehm in Waterloo Place most appropriately bears the quotation from Coriolanus, Act II., Scene III. :—

"How youngly he began to serve his country, how long continued."

His war services began at Malta in 1800, and closed in the Crimea in 1855. Sir Francis Head, who wrote his memoir in the *R.E. Professional Papers* for 1872, heads his Paper with the following anecdote :—

"Not many months ago, at a dinner party in London, an old officer said aloud and emphatically to a much older one, '*You* have done more under fire than any soldier in Europe!' 'Well,' replied the accused, in a tone of mild apology, 'but remember I have been *a long time about it*.'"

Needless to add the "much" older officer referred to was Sir John Burgoyne. He was senior officer of Engineers serving at the close of the Peninsular War in 1814, and forty years later—in his seventy-fourth year—he was serving as C.R.E. before Sebastopol.

Sir John Burgoyne died in 1871, "in the portal of his 90th year," just one year after his son, Capt. Hugh Burgoyne, V.C., R.N., went down with his ship—the ill-fated *Captain*—during a gale in the Bay of Biscay.

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The Military Opinions of Sir John Burgoyne, published in 1869, the memoir by Sir Francis Head referred to above and subsequently enlarged and reprinted in book form, and the *Life and Correspondence of Sir John Burgoyne, Bart., G.C.B.*, published by his son-in-law, Lieut.-Colonel the Hon. George Wrottesley, R.E., all remain as monuments of his *esprit de corps*, sound sense, and unfailing judgment, as well as of his long-continued and distinguished services to the country.

A bust of the fine old Field Marshal occupies a niche above his picture, the portrait of Sir Charles Pasley being surmounted by a similar bust of Sir John Jones.

The west end of the north annexe is occupied by a full-length portrait, by Charles Lutyens, of Major-General Sir William Denison. This portrait is due to the action of Sir Andrew Clarke, who had served as private secretary under Sir William Denison when the latter was Governor of Tasmania, or Van Diemen's Land as it was then called, from 1849 to 1853. When he came to Chatham as Commandant of the S.M.E. in 1881, he was surprised to find no suitable memorial in the Mess, to his old friend and chief, the originator and first editor of the *R.E. Professional Papers*.

The outcome of his advocacy of the matter at the Corps Meeting of 1882, was the portrait now hanging in the Mess, which was copied from old prints and photographs. Many references to Sir William Denison will be found in Colonel Vetch's *Life of Sir Andrew Clarke*, and few who study Sir William's career and personality will be disposed to dissent from Sir Henry Harness' verdict that he was "one of the most excellent among us."

Sir William Denison is represented in diplomatic uniform, his chief title to fame being his admirable work as Governor successively of Van Diemen's Land, New South Wales, and Madras.

For a short period in 1863, on the death of Lord Elgin, he was also acting Viceroy of India, and on that occasion "rendered a valuable service by procuring the recall of an order for the withdrawal of the troops, then engaged in the Sitána Expedition, a measure which, following as it did a temporary check sustained by the British force, could not have failed to affect injuriously our military prestige, and would probably have set the whole frontier in a blaze."*

In 1866 he returned to England as a colonel in the Corps, and was appointed C.R.E. at Portsmouth. "It is not necessary," writes Sir Henry Harness in his interesting memoir† of his old friend, "to recall the pleasure with which his brother officers received him on his return, and anticipated his being again employed among them; nor their gratification when they heard that His Royal Highness the Commander-in-Chief had offered him the Royal Engineer Command

* *Dictionary of National Biography*, Vol. XIV., p. 357.
† *R.E. Professional Papers*, 1872, Vol. XX., New Series, p. xix.

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at Portsmouth, and that he had gladly accepted it. The appointment, however, did not take place, and his letter in reply to the communication from the Inspector-General of Fortifications, which informed him that it was not considered right to send him to that duty after the high positions he had held, is so characteristic, that his friends and brother officers must wish it to be recorded in these pages.

'United Service Club, 1st July, 1867.

'My dear Sir John,

'I am much obliged to you for allowing me to see His Royal Highness's letter on the subject of my appointment as Commanding Royal Engineer at Portsmouth. I feel grateful to His Royal Highness for the testimony borne by him to the mode in which I have performed the duties incidental to the various positions in which I have been placed. I cannot but think, however, that the motives which have actuated me throughout my career have been misunderstood, and feelings alluded to, as likely to arise out of the inferiority of my present position, or of my possible future one, to those which I have held, which neither have found, nor will find a place in my mind.

'I have always had a strong Corps feeling, and have ever considered my position as an officer of Engineers an honourable distinction. I have done my best to qualify myself for the various duties which, as an officer of Engineers, I might be called upon to perform; and I have striven to induce my brother officers to take the same view as myself of the very varied character of their duties. How varied these have been in my case you know very well, but the variety was not the result of any application on my part. The offer of employment, other than that of the ordinary duties of the Corps, in every case came spontaneously from persons in authority, and I accepted the offer feeling myself competent to execute the works entrusted to me, and with a conviction that in so doing I was but acting up to my duty as an officer. I never looked upon the appointments I held as permanent; indeed they were essentially of a temporary character, and though I have been moved from one government to another, I have always looked forward to the time when I could rejoin my Corps, and as a matter of course re-assume my military position. His Royal Highness is aware that in 1865, when the question was put to me whether I intended to resign my commission, I distinctly stated that such was not my intention, and that I held myself in readiness to obey any orders I might receive from His Royal Highness. I did not then, neither do I now, think, that in re-assuming my position as a Colonel of Engineers, after having acted as a governor or governor-general, I have in any way lost caste; or that in performing the duties incidental to an officer of my rank and standing, I can be considered to be doing anything derogatory to myself—on the

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contrary, I feel that a refusal on my part to accept the realities of my position, and to perform my duties as an officer, would be equivalent to an admission that I was incapable or unfit to do so; and this most certainly I am not in any way disposed to allow. My opinion is that in returning as a matter of course to my ordinary duties in the Corps, I have but acted in accordance to a sense of duty, and as I should wish to see my brother officers do: that they appreciate my motives and are glad to see me back amongst them I have every reason to believe. Such being my feelings, and those of my brother officers, I, when asked by the Deputy Adjutant General whether I would accept the command at Portsmouth, replied at once in the affirmative; indeed I could not act otherwise, and I trust that His Royal Highness will admit that, under the circumstances, no option was left to me, and will appreciate my wish to resume my military duties.

'Believe me,

'Yours very truly,

'(Signed) W. DENISON.'"

Sir William's work, as the originator and first editor of the *R.E. Professional Papers* in 1837, has been already alluded to in the April number of the current year's *R.E. Journal*, page 229; and his work in the Survey School is referred to in the May number of the *R.E. Journal*, page 301.

Few men have done more work for the Corps, or shed more lustre upon it. "His life," writes Sir Henry Harness in the memoir already alluded to, "is an example to us and to those who are coming after us. In every passage of that life we have reason to be gratified with our brother officer, and when we regard the whole of it, we cannot but desire to preserve the memory of his career as that of one of the most excellent among us."

On the west wall of the Mess Room, facing the portrait of His Majesty the King, are two full-length portraits of Queen Victoria and the Prince Consort, painted for the Corps by Kobervin after F. Winterhalter. The originals are in one of the Royal Collections.

I have been hitherto unable to discover when these two copies were painted, but in all probability they date back to the period of the Great Exhibition of 1851, an enterprise in which the Corps played an important part.

The Prince, who had projected the idea of an International Exhibition as far back as 1849, met with great opposition in carrying his idea into effect. It was feared that a display of England's manufacturing pre-eminence would lead to a spirit of competition amongst other nations, which might in the end tell formidably upon the prosperity of the country.

The appointment in 1850 of Lieut.-Colonel W. Reid, R.E., to the

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Chairmanship of the Executive Committee of the Exhibition, saved the Prince from much anxiety in reference to the scheme which he had so much at heart. Lieut.-Colonel Reid, who obtained the assistance of many of his brother officers, as well as of the rank and file of the Corps, in the construction and organization of the Exhibition building—now the Crystal Palace—was rewarded, after the triumphant success of the Exhibition—the forerunner of so many subsequent International Exhibitions—with a civil K.C.B. in 1851.

The service thus rendered by the Corps was never forgotten by the grateful Prince, and although he was never our Colonel-in-Chief, it is fitting that we should have a permanent memorial of one whose name was so closely associated with the rise of the Corps into prominence in the middle of the last century.

NOTE.

As a result of the Notice regarding Sir Harry Jones' sword inserted on page 95 of last month's *Supplement*, I have received the following version of the story from Major-General Sir William Salmond, K.C.B. Sir William heard the details from the painter of Sir Harry Jones' portrait, Mr. E. U. Eddis, who got the account from Sir Harry himself when the latter was sitting for his portrait. The story now reads as follows :—

After the words in line 29 of page 270 *ante*, "last surviving son of Sir Harry Jones," *dele* the remainder of the paragraph and read as follows :—

"Sir Harry was the Engineer officer who led the first unsuccessful assault on San Sebastian. He was wounded in the breach and taken prisoner. At the time of the second and successful assault he was in hospital. He heard a great commotion outside, and knew from the cheers that the British were in the street. The shouts and cries of combat came closer and closer ; there was a rush up the hospital stairs, and a French officer ran in, escaping from his pursuers. Sir Harry jumped out of bed, said 'All right ; I will save you !' seized the French officer's sword, buckled on the scabbard, and interposed between the Frenchman and the British. He declared himself a British officer, and that the Frenchman was his prisoner. By this means he saved the French officer, and doubtless all the inmates of the hospital, as well as the hospital itself, for the times were rough, and when a place was sacked in those days, fire and sword were impartially merciless."

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VOLUNTEERS OF THE 18TH CENTURY.

By LIEUT. G. A. BROWN, COAST BATTN., R.E.

IN last month's *Journal*, the copy of a document was given as being probably one of the first to refer to Volunteers for Harbour Defence Work.

In the R.E. Office at Gravesend the following correspondence is recorded, and it shows that not only were the Dover Volunteers anticipated at Gravesend, but also that the credit of raising and training them was due to Lieut. Shipley, the Engineer officer in charge of the communications there.

The bargemen who formed this early Volunteer Corps were men employed "on the cheek," but whether they ever received the "pecuniary gratification"—mentioned in Lieut.-Colonel Debbieg's letter—is not recorded.

No. 1.

GRAVESEND *March the* 13*th* 1780.

DEAR SIR,

A consideration of the very great advantage that might probably arise to the Service, from having the Bargemen trained to the working of Artillery, particularly with a view to their Manning the Batteries at this Place on any occasion, induced me to sound the inclinations of the People on the Subject, and I have the pleasure to inform you, that they Unanimously Expressed their readiness and desire to be Employed in this double Capacity, 'tis only necessary for me to say further, that the Effecting this purpose will not be attended with the smallest Expense, and that I will undertake in a very short time to make them sufficiently expert, either with, or without the assistance of a small Party of Artillery Men, when this matter is determined upon, it may perhaps be worthy of Consideration, whether it would not be more advantagious to Work the Guns with Tackles, in like manner as on Board of Ship, than in the usual manner with Handspikes.

o o o o o

I am Dear Sir

Your Most Obedient and Most Humble Servant

CHARLES SHIPLEY.

LIEUT.-COLONEL DEBBIEG.

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No 2.

LONDON *March the* 15*th* 1780.

DEAR SIR,

Lord Amherst has approved of the Bargemen being Employed at the Exercise of the Great Guns, but a Party of Artillery Men cannot be had, so if you make any progress therein, you will have all the Credit of it to yourself.

If the Men persevere and become Expert at the Business, I have no doubt but his Lordship will order them some pecuniary gratification for their trouble.

I am Dear Sir
Your Most Obedient Humble Servant
HUGH DEBBIEG.

LIEUT. SHIPLEY.
Gravesend.

No. 3.

GRAVESEND *March the* 20*th* 1780.

DEAR SIR,

I deferred acknowledging the Receipt of your Letter of the 15th Instant, till I had it in my power to acquaint you that the Bargemen who are this Week upon full Pay, have already made such progress in their New Employment, as to convince me that a very short time will make them as Expert as can be desired. Under this perswasion, I am therefore to request, that as soon as I shall Report to you that the whole are perfect in the manner of Loading, Firing, laying, and otherwise Working the Garrison Guns, that you will take the trouble to see them perform, and that you will then Report as you think they deserve.

I am glad to tell you that we scarcely feel the want of the assistance of a Party of Artillery Men.

I am Dear Sir
Your Most Obedient and Most Humble Servant
CHARLES SHIPLEY.

LIEUT.-COLONEL DEBBIEG.

No. 4.

GRAVESEND *March the* 26*th* 1780.

DEAR SIR,

o o o o o

Three of the Bargemen who were upon full Pay the last week, are as expert in the working of the Guns, as can be desired, and I have no doubt, but that the remainder will be so in a fortnight, this business having Succeeded So well hitherto induces me further to propose, that the People should be trained to the Exercise of the light Artillery in order to render them of the most general utility possible in the Defence either in the Field, or in Garrison of any part of this Country should it be invaded. I am therefore to request (should this proposal meet with your approbation) that you would apply for Two Six Pounder Field Pieces compleat to be sent as soon as possible to Gravesend, for the purpose of my instructing the Bargemen in the use of them, the very small number of Artillery now in the Kingdom renders it an Object of the utmost

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importance to supply the want of them by every means possible, and the accomplishing this purpose in the present instance, so as to have (when the high Establishment takes place) Ninety able-bodied Men, well trained to the Exercise of Garrison and Field Artillery, will be attended with little or no Expense, will not at all interfere with any other part of their Duty, and so far from creating any degree of Jealousy in their minds, that I can with Confidence affirm from their own volantary Declaration that they are so sensible of the Comforts and attention afforded them by Government, they shall rejoice in the occasion of exerting themselves to the utmost of their power in the performance of any Duty allotted them,

The Field Pieces may be sent from the Tower to Gravesend by Water, and returned when done with (by the same conveyance) with little trouble or Expense.

With respect to what I mentioned of the Working of Guns with Tackles as on Board of Ship, I find upon Tryal that Handspikes as being more simple, have in general the advantage, and best adapted to a Mixture of People, who might on any occasion be Joined with the Bargemen,

The Protections for the Ensuing Fortnight Arrived Yesterday.

I am with the greatest Regard Dear Sir
Your Most Obedient and Most Humble Servant
CHARLES SHIPLEY.

LIEUT.-COLONEL DEBBIEG.

No. 5.

GRAVESEND *April the 27th* 1780.

SIR,

I am now to report to you that the whole of the Bargemen on the present Establishment are as Expert in the Exercise of the Great Guns as can be desired, I should be wanting in common Justice to them, was I to omit assuring you of the Alacrity and good Humour with which they undertook and have gone through this Extra Duty. The accomplishing of this Business has been attended with the Expenditure of a small Quantity of Powder, I believe about Eight Barrels in the whole, which was furnished by Mr. Aked at my particular instance, which I flatter myself will be thought a trifling Consideration, in comparison to the benefits that may arise from the Bargemen being so taught.

o o o o o

I am Sir
Your Most Obedient Humble Servant
CHARLES SHIPLEY.

LIEUT.-COLONEL DEBBIEG.

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TRANSCRIPT.

THE FRENCH AND ITALIAN BRIDGING TRAINS.

(Transcript from the *Memorial de Ingenieros*).

In May, 1905, a Commission, composed of one colonel and one lieutenant-colonel of Engineers, was sent by the Spanish Government to report on engineer matters in France and Italy.

Their report has been published in a recent issue of the *Memorial de Ingenieros*, and is divided into two parts, the first dealing with barrack construction, and illustrated with numerous views and diagrams of barrack and hospital buildings, and the second with bridging material. The consideration of the first part is deferred to a later date, but the following is a somewhat condensed translation of the part relating to bridges.

The Commission was directed to report on the following subjects:—

1. Wheeled transport. (*a*). Vanguard bridging trains; their organization, composition, length of bridge, weight and loads of the vehicles on which the material is transported, total weight behind the teams, the teams and the tractive force required to be exerted by each animal.

(*b*). Army and Corps bridging trains. The same particulars as in (*a*), and in addition all details referring to their organization and its adaptation to the organization of the armies of France and Italy respectively.

2. Mountain bridging train. Its organization, composition, number of pack loads of which it is formed, weight of the loads, method of transport, and length of bridge which can be constructed by each bridging unit, special attention being devoted to the methods of forming the bays.

The Commission commences its report by a historical summary of military bridging. It divides the subject into eight periods.

First period, from the earliest times up to the 4th century A.D., in which the portable material consisted of light boats carried on pack animals. No superstructure was carried, the necessary material for it being taken from woods adjacent to the site of the bridge.

Second period, from the 5th to the 15th centuries A.D., during which portable bridging trains were unknown.

Third period, up to the middle of the 17th century, during which time military bridges were usually constructed of material locally available, though very heavy bridging trains were sometimes used.

Fourth period, from the middle of the 17th to the end of the 18th century, during which light bridging trains were introduced. The buoyancy of the points of support was diminished, as well as the weight of the superstructure. The results were at first unsatisfactory, and attempts

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were then made to increase the buoyancy by using metal instead of wooden supports. The Dutch were the first to use sheet-iron pontoons, and were soon followed by other nations. The backward state of the science of metallurgy prevented these experiments from attaining much success, with the result that portable bridging trains again became discredited.

Fifth period, from the end of the 18th century to the fall of the French Empire. Wooden pontoons of large dimensions were re-introduced. The Austrian pattern, intermediate in size between the heavy pontoons of the third and commencement of the fourth period and the light metal pontoons of the fourth period, was generally adopted.

Sixth period, from 1813 to 1840. Light pontoons similar to those of the fourth period were re-introduced. This proved to be a retrograde step.

Seventh period, marked by the introduction of the Birago pontoon, the invention of an Austrian lieutenant-colonel. This invention produced a veritable revolution in the composition of bridging trains, though the only thoroughly original feature was the two-legged trestle. The Birago material was accepted by most nations, subject to a few unimportant modifications.

Eighth or present period. Defects began to be found in the Birago material, and improvements in metallurgy enabled metal pontoons to be constructed with success. Two distinctive patterns have been evolved, the one in Sweden (the Normann system), the other in Denmark and Holland. The latter has preserved the Birago trestle with notable improvements, but has entirely altered and lightened the pontoon without in any way weakening it. Spain, Norway, Chile, and Argentina have adopted the Danish system, which the Commission considers to be far in advance of all others.

England has adhered to its material, characterized by a pontoon of canvas, wood, and cork, fitted with a saddle; Belgium retains the Thierry three-legged trestle, whilst France and Italy have, probably from motives of economy, retained their old equipment.

FRANCE.

A description of the organization of the French Engineers will be found in the *R.E. Journal* for August, 1908.

The Commission visited the bridging school of the detached battalion at Toul, on the Moselle, and that of the 7th Regiment during the manœuvres on the Rhone, between Vienne and Avignon.

1. WHEELED TRANSPORT.

(*a*). *Vanguard Bridging Trains.*

Up to the present France has not adopted a vanguard bridging train. At the same time it is recognized that the existing equipment is much too heavy and cumbrous, and is deficient in the mobility which has been acquired by all arms of the service. Experiments have therefore been

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made for the purpose of finding a more suitable equipment, and the matter has received much attention in the military press.

In the park of the 7th Regiment the Commission was shown the material proposed by Capt. Benard, of the French Engineers, for service with the cavalry.

The Benard material is transported on a four-wheeled wagon formed like a cage, that is to say, with high sides united by canvas bands between which are packed four metal pontoons of small dimensions, similar in type to the Swedish boats, and to the Spanish ones of the Monteverde system. Three of these pontoons are of equal size; the fourth is smaller, so as to admit of its being packed inside one of the former. The centre of gravity of the load is high, and there is great risk of the wagon upsetting on all but the best roads. The pontoons are packed one on the top of the other. The superstructure is composed of four baulks, chesses, saddles, and oars. The Commission do not consider it necessary to give the weights and dimensions.

The Very equipment was tried at Lunéville during the French manœuvres in August, 1906. The Commission did not have an opportunity of seeing it, but learnt that three canvas boats, which could be folded and carried on pack animals if necessary, were carried in each vehicle. The buoyancy is 1,500 kg. (3,300 lbs.). The superstructure, composed of baulks and chesses, is suitable for widths of roadway from 0·65 m. (2′ 2″) to 2·50 m. (8′ 2″). This information is sufficient for the Commission to be of opinion that the system is not one which is worthy of imitation, and that it is very unlikely that it will be adopted in the French service.

The exceedingly important reconnaissance duties entrusted to the cavalry have led to the idea of giving to that arm a means of crossing small streams and obstacles of a breadth not exceeding 20 to 25 m. (65′ to 80′), above which the regular bridging trains of the Engineers must be employed.

This idea seems a very plausible one, but it has not yet taken a practical form. Troops detached for reconnoitring purposes must necessarily be weak in number and incapable of much resistance, and as they require the maximum of mobility they cannot be encumbered with a number of vehicles. An attempt has been made to reduce the weight of these vehicles, but the only result has been to reduce very largely the efficiency of the material carried by them, so that it is but little better than that which might be found at the spot where a bridge had to be made. Its application in streams having a current exceeding 1 m. a second (about 2 miles an hour) would be either impossible or dangerous. It would generally be better either to ford or swim such streams rather than to use bridging material of insufficient strength. Flying bridges might often be of value, but a trained *personnel* is necessary for their use.

The Commission will not say that the problem is being abandoned, but it must be approached with great care and by persons thoroughly competent to deal with it. The Vanguard sections carrying 15 m. (15 yards) of bridge, which have been mentioned in the professional press, do not seem to exist in France.

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(*b*). *Bridging Trains.*

In France there are army corps and army bridging trains.

The army corps equipment is organized in two divisions and a reserve.

Each division consists of—

	Vehicles.
1 superstructure section	2
1 trestle section	2
4 pontoon sections	12
1 field forge section	2
Total	18

The reserve section consists of 1 bridging and 1 store wagon. The corps bridging train therefore consists of 38 vehicles.

The superstructure section of the 1st Division contains one box of instruments, model 1877.

The field forge section consists of 1 forage cart, 1 field forge, and 1 wagon for smiths' tools, etc. Independently of these vehicles each corps bridging train has 6 supply wagons and 1 store wagon.

The army bridging train is formed of 2 corps trains, and consequently consists of 4 divisions and a reserve. Each of the divisions is organized similarly to those of a corps bridging train. The complete train is therefore composed of 76 vehicles. The auxiliary vehicles necessary for the service of the two park sections and for the transport of supplies and stores are the following:—2 field forges, 2 park wagons, 2 forage carts, 12 supply wagons, and 2 store wagons.

A corps bridging train can make 123 m. (134 yds.) of bridge.

The points of support are formed by single wooden pontoons, of which there are 16 in the train, and four Birago trestles. The wooden pontoons are being gradually replaced by metal ones of galvanized iron of the Prussian type, the ends being raised, so as to make anchoring less difficult. Legs of three different lengths are used in the trestles. In each bay of trestles there are two baulks with claws, used on the outside of the roadway; the remainder are plain.

The superstructure rests directly on the gunwales of the pontoons, to which the outer baulks, which are smooth and of a special pattern, are lashed.

The following table, taken from the official regulations, details the number, weight, distribution, etc., of the equipment of a corps bridging train:—

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Detailed Composition of a French Corps Bridging Train.

Description.	Weight of the Unit.	Number.	Distribution.				
			Reserve.	Superstructure Section.	Trestle Section.	Pontoon Section.	Field Forge Section.
Vehicles.	kg.						
Park wagons	919·00	15	1	2	2	8	2
Field forges	1102·00	2	—	—	—	—	2
Material wagons	914·00	21	1	2	2	16	—
Total		38	2	4	4	24	4
Supports.							
Pontoons	660·00	16	—	—	—	16	—
Two-legged trestles complete	170·00	6	—	—	6	—	—
Each trestle consists of—							
1 transom ... kg.	98						
2 legs, 3 m. long ... ,,	40						
2 suspension chains ... ,,	16						
2 shoes ... ,,	16						
Total ... ,,	170						
Boats	450·00	2	—	2	—	—	—
Superstructure.							
Saddles	56·00	4	—	4	—	—	—
Chesses	24·00	392	—	40	64	288	—
Baulks: for lashing	43·00	42	—	28	14	—	—
Baulks: clawed	44·00	16	—	—	16	—	—
Baulks: ordinary	55·00	119	7	—	—	112	—
Baulks: cut	14·00	14	2	12	—	—	—
Cordage.							
Lashings	7·50	64	16	12	4	32	—
Two-strand ropes	0·65	32	32	—	—	—	—
Lashings: rack	0·03	188	—	30	38	120	—
Lashings: small	0·40	180	—	30	30	120	—
Lashings: for baulks	0·30	460	18	36	60	272	—
Anchor cables	43·00	22	—	4	—	16	2
Other cables	27·00	3	1	—	—	—	2
Tow-ropes: for horses	42·00	4	2	—	—	—	2
Tow-ropes: ,, men	5·00	10	—	2	—	8	—
Miscellaneous.							
Anchors	65·00	16	—	—	—	16	—
Ribands	8·00	12	—	2	2	8	—
Rack sticks	0·30	180	—	30	30	120	—
Suspension chains: long (12′ 6″)	4·50	12	—	2	2	8	—
Suspension chains: short (9′ 0″)	3·40	12	—	2	2	8	—
Spikes	0·50	40	—	—	—	—	40
Dogs	0·50	40	—	—	—	—	40
Lashing-chains, with wedges	6·80	24	8	16	—	—	—
Jacks: large	46·00	1	1	—	—	—	—
Jacks: small	32·00	2	—	—	2	—	—
Balers: large	1·70	18	—	2	—	16	—
Balers: small	1.00	18	—	2	—	16	—
Tackle	15·00	1	1	—	—	—	—
Two-pointed boathooks: pontoon	5·70	80	—	—	—	80	—
Two-pointed boathooks: boat	4·25	6	—	6	—	—	—
Boathooks, with point and hook	5·50	16	—	—	—	16	—
Grapnels	15·00	2	—	2	—	—	—
Light boathooks	3·50	4	—	—	—	—	4
Apparatus for flying bridge	7·50	2	2	—	—	—	—
Winch	65·00	1	1	—	—	—	—
Pickets: large	9·50	24	—	24	—	—	—
Pickets: small	6·00	20	—	20	—	—	—
Pumps	11·55	4	—	—	4	—	—
Megaphones	0·50	2	—	—	—	—	2
Wooden blocks	7·00	4	—	—	—	—	4
Oars: pontoon	7·00	96	—	—	—	96	—
Oars: boat, ordinary	3·00	10	—	10	—	—	—
Oars: boat, bound with iron	4·00	2	—	2	—	—	—
Rowlocks: for steering	0·30	72	—	8	—	64	—
Rowlocks: for rowing	0·10	180	—	20	—	160	—
Transoms	11·00	4	—	—	4	—	—

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The equipment also includes tools, repairing materials, wire, topographical and drawing instruments, etc.

The weight of the metal pontoon is 685 kg.

LOADS OF THE VEHICLES.

Superstructure Section.

		Number.	Weight. Kgs.
Bridge wagon	Baulks	14	602
	Boat	1	450
	Lashings	6	1·80
	Saddles	2	112
	Boat-oars { ordinary ...	5	15
	Boat-oars { iron-bound ...	1	4
	Boathooks	3	12·75
	Rowlocks { steering ...	4	1·20
	Rowlocks { rowing ...	10	1
	Balers { large	1	1·70
	Balers { small	1	1
	Tools, etc.	4	—
	Total weight of loaded wagon		2210

Park wagon	Chesses	20	480
	Pickets { large	12	114
	Pickets { small	10	60
	Anchor cables	2	86
	Warps	6	45
	Lashings { for baulks ...	22	6·60
	Lashings { miscellaneous ...	15	6
	Lashings { rack	15	0·45
	Various	—	—
	Approximate weight of loaded wagon		2110

Trestle Section.

Bridge wagon	Baulks	7	301
	Shore-end transom ...	2	22
	Trestle transom	3	297
	Lashings { ordinary	6	1·80
	Lashings { with rack stick...	4	0·12
	Legs { 2 m....	4	52
	Legs { 3 m....	6	120
	Shoes	6	45
	Suspension chains	6	48
	Baulks with claws	8	352
	Legs, 3·90 m.	4	108
	Various	—	—
	Approximate weight of loaded wagon		2270

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Park wagon	Chesses	32	768
	Lashings for baulks ...	24	7·20
	Lashings miscellaneous ...	15	6
	Lashings rack	15	0·45
	Shoes	1	7·50
	Warps	2	15
	Various	—	—
	Approximate weight of wagon		2160

Pontoon Section.

Bridge wagon	Baulks	7	385
	Pontoon	1	660
	Lashings	5	1·50
	Anchors	1	65
	Rowlocks for oars ...	10	1
	Rowlocks „ steering ...	4	1·20
	Boathooks with spike ...	5	28·50
	Boathooks „ „ and hook ...	1	5·50
	Balers large	1	1·70
	Balers small	1	1
	Tools, etc.	—	—
	Approximate weight of loaded wagon		2120

Park wagon	Chesses	36	864
	Anchor cables	2	86
	Warps	4	30
	Lashings baulks	24	7
	Lashings miscellaneous ...	15	6
	Lashings rack	15	0·45
	Various	—	—
	Approximate weight of loaded wagon		2120

Field Forge Section.

Field forge	There are two marks of wagon, one of 1827, the other of 1827 improved. The first weighs 1,640 kg., the second 1,810 kg., and holds a larger amount of coal.
Park wagon	Various articles. Approximate weight, 2,030 kg.

Reserve.

Bridge wagon	1870 kg.
Park „	2020 „

DESCRIPTION OF THE PARTS OF THE BRIDGE.

Vehicles.—Besides the field forge wagon, there exist two different types of vehicle, the park wagon for chesses (*charriot de parc*) and the pontoon wagon (*haquet*), both without springs and drawn by six horses. Their weight empty is 919 and 914 kg. respectively.

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Pontoon (*Fig. a*).—Of wood, with iron fittings; total weight, 660 kg.; length, 9 m. 43; breadth over all, 1 m. 76; depth at centre, 0 m. 785.

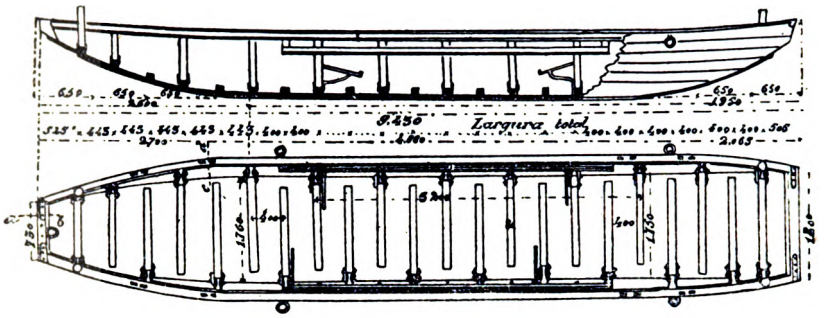

FIG. *a*.

A galvanized steel pontoon of German type is being introduced, with pointed ends, plating equally thick throughout. Its weight exceeds that of the wood pontoon by 20 kg.

Trestle.—Birago system. Trestle, length 5 m. 37, section 0 m. 20 × 0 m. 22 at the ends, and 0 m. 23 × 0 m. 16 elsewhere. Weight, 99 kg. Two legs 3 m. long, two legs 3 m. 90 long, and two legs 2 m. long.

Shoes of oak.

Inclination of the legs = 70°.

Boat, length, 9 m. 08; width at centre, 1 m. 57; depth at centre, 0 m. 49.

Anchor, of iron; weight, 65 kg.

Chesses, 3 m. 90 × 0 m. 933 × 0 m. 04.

Baulks.—With claws; length, 6 m., section 0 m. 12 × 0 m. 12.

For lashing	,,	6 m. 30,	,,	,,
Cut	,,	2 m.,	,,	,,
Ordinary	,,	8 m.,	,,	,,

Tractive Force.—As this is so variable, depending on the state of the track, for the same vehicle and team the Commission assumed:—

1. That for the same loads the tractive force is inversely proportional to the diameter of the wheels.
2. That the useful tractive force which each animal has to exercise, according as there are six, four, or three in each team, is relatively proportional to the numbers 7, 8, and 9.

For the French equipment we have the following data:—

Springless Wagon.

Weight of pontoon wagon		2120 kg.
,, park ,, ...		2020 ,,
Horses		6
Mean diameter of wheels	pontoon wagon ...	1·35 m.
	park , ...	1·315 m.

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Therefore, dividing the weight of the loaded vehicles by the number of horses, by the mean diameter of the wheels, and by 7, as there are six horses in the team, and multiplying the quotient by 5, as the vehicle is without springs, we obtain as coefficients of traction—

For the pontoon wagon, 187
„ park „ 184

Six-horse teams are preferable to four-horse teams, such as are used in Spain. With this exception, there is nothing in the organization of the French 6th and 7th Engineer Regiments (pontoniers) worthy of imitating.

2. Mountain Bridging Train.

There is no mountain bridging train in France. The Commission believes that, with the exception of the Berthon equipment used by the English in India, which can be transported either in two-wheeled carts or on pack animals, the Pfund, employed in Argentina, which only admits of the passage of foot soldiers, and then only with great precautions, and the Very equipment described above, no army has attempted to resolve, nor even to sketch out, a solution of the problem.

Only in Spain, on the occasion of the war in Africa in 1859 and 1860, has the question of a bridging train to be carried on the backs of mules or camels been considered. The Terrer equipment, an application of the Birago trestle, was offered as a solution, and remains as the Spanish regulation mountain equipment, which rendered useful services during the last Civil War. The greater mobility required by armies at the present time has demonstrated its deficiencies, and the Regiment of Pontoniers (Spanish) has just finished the design of a more mobile equipment, in which the advances made by science in the last few years have been utilized.

ITALY.

Organization and Duties of the Corps of Engineers.

The Corps of Engineers consists of sappers and miners, telegraphists, railwaymen, pontoniers, train, and *lagunari*, and also deals with ballooning, visual signalling, electric lighting, and carrier pigeons. In addition, it is charged with the construction, improvement, maintenance, and administration of fortifications and military buildings. It is organized into two inspectorates, six commands, five regiments, one railway brigade, fifteen directorates for the service of the Territorial Army, and two separate directorates and offices for the service of the Royal Navy. It is also in charge of the workshops for the construction of engineer material.

The inspectorates are directly subordinate to the War Minister, and comprise the Consultative Committee and the committee dealing with Engineer troops and buildings.

The Chief Engineers have in relation to the troops a status analogous to that of Generals of Brigade. The Chief Engineer is directly subordinate to the General Commanding his army corps.

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TECHNICAL SERVICES.

The technical administrative services of the Engineers embrace the construction, maintenance, and administration of military buildings of all kinds; the production of the mobile material necessary for the various services of the Engineer arm, including vehicles, and the production of various barrack stores.

The use to which each building is to be allotted is dictated by the Minister of War. In urgent cases the General Officer commanding a corps or division may temporarily alter the allotment of a building, provided that the matter is not of great importance, and that it is reported to the War Office.

For the construction and maintenance of buildings the directorate make use of the sums placed at their disposal by the War Office. The directorates keep up to date the plans and inventories of the property which they administer, and when necessary carry out new works and plans, issue information on which public tenders are based, and enter into contracts in conformity with the Regulations of 1881.

Mobile material is produced by the Engineer workshops at Pavia, where raw materials are purchased and all necessary articles manufactured. A few articles are bought in the open market.

The audit of the Engineer accounts is carried out by the audit office attached to the inspectorate of engineering construction.

The Engineer troops are distributed as follows :—

Engineer Regiments.		Companies.	
Regiment.	Station.	Technical.	Train.
1st (Pavia) ...	Sappers (Pavia, Rome, Mesina)	12	—
	Train	—	2
2nd (Casala) ...	Sappers (Casala and Bologna)	12	—
	Train	—	2
3rd (Florence) ...	Telegraphists (Florence, Verona, Placencia) ...	12	—
	Specialists, Balloons, etc. (Rome)	2	—
	Train	—	2
4th (Placencia)...	Pontoniers (Placencia, Verona, Rome)	8	—
	Lagunari (Venice)	2	—
	Train	—	3
5th (Turin) ...	Miners (Turin, Albenga)	12	—
	Train	—	1
	Railway (Turin)	6	—
	Total ...	66	10

Each regiment has a regimental staff and a depôt. The Railway Brigade has a brigade staff.

On mobilization, 58 companies of Engineers are formed from the mobile militia for various duties, four being train companies.

The *lagunari* are for water transport at Venice and on the lagoons.

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WHEELED TRANSPORT.

(*a*). *Vanguard Bridging Trains.*

The subject has been very fully considered in Italian military periodicals. Reference should be made to Colonel Rocchi's article in the *Rivista di Artiglieria é Genio*, 1885, Vol. I., p. 67; *I ponti portatili ed il loro impiego in guerra*, by Mirandoli, Vol. IV., p. 461; *Le sezioni da ponte per zappatori addette alledivisioni de Bignami*, 1894, Vol. I., p. 438; *I ponti de avanguardia divisionali*, by Spaccamela, 1899, Vol. II., p. 49; *Studio di un ponte metallico di avanguardia*, by Guada, 1900, Vol. II., p. 382; and *Il ponte metallico di avanguardia*, by Capt. Maggiorotti, 1901, Vol. III., p. 222.

A satisfactory solution has, however, not been attained, but the duties are carried out by the bridging sections which are attached to Engineer regiments, and carry sufficient material for the construction of—

A pontoon bridge, 21 m. (23 yds.) long.
A trestle bridge, 34 m. 20 (38 yds.) long.
A bridge of three trestles and one pontoon, 34 m. 40 (38 yds.) long.
A bridge of two trestles and two pontoons, 34 m. 60 (38 yds.) long.

Exceptionally, and by using only five baulks to a bay, there can be constructed—

A bridge of four trestles and one pontoon, 41 m. 20 (45 yds.) long,
A bridge of three trestles and two pontoons, 41 m. 40 (45 yds.) long,

neither of which will take loaded vehicles.

If half-pontoons are used as points of support, footbridges can be constructed to carry infantry across streams with a slow current.

The bridging section may be divided into two halves, identical in composition and organization.

Detail of the Material of a Bridging Section.

Article.	Distribution in the Vehicles.			Weight of each Unit.	Total Number.
	Transport.	Pontoon.	Trestle.		
Vehicles.				kg.	
Pontoon wagons	—	1	—	730	4
Trestle ,, ...	—	—	1	760	2
Transport ,, (Model 1876)... ...	1	—	—	895	1
Supports.					
Transoms	—	—	2	118	4
Saddles	—	1	—	3·15	4
Short legs	—	—	4	15	8
Medium ,, ...	—	—	4	20	8
Long ,, 6 m. (20′)	—	—	4	34	8
5 m. legs (16′ 6″)...	—	—	4	29	8
Half-pontoons	—	1	—	380	4
Suspension chains	—	—	4	11	8
Shoes (sets)	1	—	—	2·70	1

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Detail of the Material of a Bridging Section.—Continued.

Article.	Distribution in the Vehicles.			Weight of each Unit.	Number.
	Transport.	Pontoon.	Trestle.		
Superstructure.					
Half-chesses	—	2	—	10·50	8
Chesses	—	29	14	15·25	144
Gunwale baulks	—	3	—	12	12
Saddles, with pins	—	—	2	40	4
,, without pins	—	—	2	35	4
Roadbearers	—	8	—	65	32
Rope.					
Anchor cables	—	1	—	35	4
Ropes for horses	1	—	1	2·70	3
Ropes	—	2	1	4·10	10
Baulk and wagon lashings	—	4	—	1·60	16
Rack lashings	—	15	5	0·515	70
Miscellaneous.					
Anchors	—	1	—	65	4
Anchorages	—	1	—	3·15	4
Boathooks	—	—	1	7	2
Pickets—small	—	—	4	5·66	8
Pickets—large	—	—	2	15·50	4
Pickets—medium	—	—	2	10·75	4
Pickets—for horses	2	—	—	3·87	2
Oars	—	14	—	6·66	56
Balers	—	1	—	0·65	4

The equipment also comprises entrenching tools, smiths' and carpenters' tools, lanterns, and materials for extemporized bridges.

Vehicles.

Pontoon wagon

Weight of wagon empty	730 kg.
,, ,, ,, loaded ...	2140 ,,
Height ,, ,, ,, ...	2·44 m.
Length ,, ,, without pole ...	7·46 m.
Width ,, ,, over all ...	3·50 m.
Track of wheels	1·58 m.

This wagon carries half a pontoon with its equipment, 8 baulks, 26 chesses, 1 box, etc.

Trestle wagon

Weight of wagon empty	760 kg.
,, ,, ,, loaded ...	1970 ,,
Height ,, ,, ,, ...	1·82 m.
Length ,, ,, without pole ...	6·65 m.
Width ,, ,, over all ...	2·96 m.
Track of wheels	1·58 m.

This wagon carries 2 transoms, 4 large, 4 medium, and 4 short legs. 14 chesses, 2 chock-baulks, and 2 baulks.

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Ordinary transport wagon, model 1876.	Weight of wagon empty	893 kg.
	Length „ „ without pole ...	3·622 m.
	Width „ „ over all ...	1·905 m.
	Track of wheels	1·36 m.

This wagon carries articles of equipment and general service, provisions and forage, and also a few accessories for the wagons of the section.

DESCRIPTION OF THE PARTS OF THE BRIDGE.

This equipment is modelled on the Birago, and is a lighter form of that which will presently be described. It differs from the Austrian patterns in details of organization, in the form of the pontoons, in the method of fastening them together, in the transoms and saddles having pins fitting into holes in the baulks, which are not provided with claws.

Trestle.—Birago system, with legs of four different lengths, and wooden shoes.

Transom.—Length, 5·22 m.; depth, 0·23 m.; width at the ends 0·21 m., in the middle 0·16 m.

Legs.—Lengths 6 m., section 0·09 m. × 0·12 m.; 5 m., section 0·09 m. × 0·12 m.; 4 m., section 0·09 m. × 0·15 m.; 2·50 m., section 0·09 m. × 0·15 m.

Suspension Chains.—Length, 2 m.; diameter of the iron of the links, 0·015 m.

Pontoon.—Cavalli system. Wooden, trapezoidal, bi-partite. Length of pontoon 7·86 m., and of one section 4·38 m. Width across the gunwales, 1·91 m.; at the bottom, 1·42 m. Weight, 600 kg. Weight of anchor, 65 kg.

Baulk.—Length 7 m., section 0·11 m. × 0·15 m.

Chesses.—Length 3·27 m., section 0·04 m. × 0·29 m.

Loads of the Vehicles.

Pontoon wagon	Chesses	26	Trestle wagon	Legs, 2·50 m. ...	4
	Baulks	8		Pickets	8
	Sections of pontoon	1		Shoes	4
	Saddle	1		Suspension chains	4
Inside pontoon	Chesses	3		Legs, 4 m. ...	4
	Medium chesses ...	2		„ 5 m. ...	4
	Anchor cables ...	1		„ 6 m. ...	4
	Oars	3		Boathooks ...	1
	Anchor	1		Baulks	4
	Box of tools and caulkers' tools, etc.	1		Transoms ...	2
				Chesses	14
				Rope, etc. ...	—

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ARMY AND ARMY CORPS BRIDGING TRAINS.

As already stated, the 4th Engineer Regiment is organized for the bridging services of the Army. It is composed of—

Regimental staff, 3 brigades of pontoniers (8 companies), 1 brigade of *lagunari* (2 companies), 3 companies of train, and 1 depôt company, with an effective total of 59 officers and 1,534 pontoniers.

On mobilization the companies become independent and have an establishment of 5 officers and 240 pontoniers each, except the *lagunari*, which have 5 officers and 340 pontoniers each.

The distribution of the bridging trains, according to circumstances, is determined by higher authority. In general the army corps are not provided with bridging trains, the divisions having each only one bridging section, as already described.

The equipment consists of 46 wagons, viz. :—22 pontoon and baulk wagons, 5 pontoon and chess wagons, 3 trestle wagons, 10 chess wagons, 1 boat wagon, 3 transport wagons, 1 park wagon, and 1 field forge. Each set of equipment contains material for the construction of 196 m. (217 yds.) of pontoon bridge, and 28 m. (31 yds.) trestle bridge, *i.e.*, for 216 m. (240 yds.) of mixed bridge.

The transport is effected by a section of the train, and the bridging duties are performed by one company of pontoniers.

The total quantity of bridging material is 3,000 m. (nearly two miles).

The system is founded on the principles of Cavalli, and is analogous to that of the bridging sections already described, the dimensions of the parts and the organization being varied.

The pontoon is of the Cavalli type, and the trestle of the Birago type.

The baulks are without claws, and are provided with holes into which the pins on the transoms and saddles fit.

The chesses are fixed by baulks racked down to them.

The following is a list of the principal parts of the equipment :—

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Composition of a Bridging Train.

Article.	Total Number in the Train.	Distribution of Articles to the Wagons.									Average Weight in Kilos.
		Pontoon and Baulks.	Pontoon and Chesses.	Chesses.		Trestle.	Boat.	Park.	Transport.	Field Forge.	
				8 First.	9th & 10th.						
Number of wagons	46	22	5	8	2	3	1	1	3	1	
Wagons.											
Transport wagons	3	—	—	—	—	—	—	—	1	—	912
Park wagons, covered ...	1	—	—	—	—	—	—	1	—	—	925
Pontoon and baulk wagons, model 1860	22	1	—	—	—	—	—	—	—	—	720
Pontoon and chess wagons, model 1860	5	—	1	—	—	—	—	—	—	—	759
Trestle or chess wagons ...	13	—	—	1	1	1	—	—	—	—	724
Field forge wagon	1	—	—	—	—	—	—	—	—	1	1184
Supports.											
Transoms, model 1860 ...	9	—	—	—	—	3	—	—	—	—	110
Pontoons, model 1860 ...	27	1	1	—	—	—	—	—	—	—	540
Boats	2	—	—	—	—	—	2	—	—	—	300
Suspension chains	18	—	—	—	—	6	—	—	—	—	11
Anchorages	27	1	1	—	—	—	—	—	—	—	3·15
Trestle legs { short	18	—	—	—	—	6	—	—	—	—	15
Trestle legs { medium	9	—	—	—	—	3	—	—	—	—	27
Trestle legs { long	6	—	—	—	—	2	—	—	—	—	40
Shoes	18	—	—	—	—	6	—	—	—	—	8
Baulks	149	5	5	—	—	—	—	—	—	—	8·80
Cut baulks	54	2	2	—	—	—	—	—	—	—	3·50
Saddles { with pins	9	—	—	—	—	3	—	—	—	—	35
Saddles { without pins ...	9	—	—	—	—	3	—	—	—	—	31
Superstructure.											
Half-chesses	54	2	2	—	—	—	—	—	—	—	6·50
Chesses...	709	3	25	50	50	6	—	—	—	—	23·50
Baulks	220	10	—	—	—	—	—	—	—	—	55
Lashings without rack sticks...	346	8	8	—	2	4	14	100	—	—	0·535
,, with ,, ,, ...	408	8	8	—	—	64	—	—	—	—	0·66
Lashings	54	2	2	—	—	—	—	—	—	—	1·06
Wedges	108	4	4	—	—	—	—	—	—	—	1·33
Rope.											
Anchor cables, model 1860 ..	33	1	1	—	—	—	—	6	—	—	41
Large anchor cables for the P.O.	2	—	—	—	—	—	—	2	—	—	74
Ropes	72	2	2	1	1	—	—	8	—	—	4·70
Lashings	112	4	4	—	—	—	—	4	—	—	1·60
Cables	4	—	—	—	—	—	—	4	—	—	50
,, for boat grapnels ...	2	—	—	—	—	—	2	—	—	—	7·50
Rope	1	—	—	—	—	—	1	—	—	—	2·00
Horse ropes	18	—	—	1	1	1	—	1	1	1	3·50
Spun yarn	59 kg.	—	—	—	—	—	12 kg.	45 kg.	—	2 kg.	—
Miscellaneous.											
Anchors, model 1860... ..	29	1	1	—	1	—	—	—	—	—	65
Grapnels	2	—	—	—	—	—	2	—	—	—	22
Balers	35	1	1	—	—	2	2	—	—	—	0·65
Boathooks	16	1	1	—	—	—	2	—	—	—	7
Wells' lights	1	—	—	—	—	—	—	—	—	1	123
Pickets { short	18	—	—	—	—	6	—	—	—	—	5·66
Pickets { long	9	—	—	—	—	3	—	—	—	—	15·55
Pickets { medium	29	—	—	—	2	9	2	—	—	—	10·75
Pickets for horses	40	—	—	2	—	2	—	6	2	2	3·87
Oars	158	5	5	—	—	—	10	—	—	—	8·30
Spars	54	2	2	—	—	—	—	—	—	—	2·20

Also tools of various kinds, lanterns, and materials for extemporized bridges.

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DESCRIPTION OF THE DIFFERENT PARTS OF THE BRIDGE.

Pontoon (*Fig. b*).—Of wood, Cavalli type, with stern square, so as to enable two to be joined together in heavy bridge and rafts. Length, 7·50 m. Width at the gunwales, 1·76 m.; at the bottom, 1·32 m. Depth at the bow, 1·10 m.; at the stern, 0·80 m.; where the bow commences to curve, 0·90 m. Cubic capacity, 10·300 cubic mètres. Weight, 540 kg. Buoyancy, 9,400 kg.

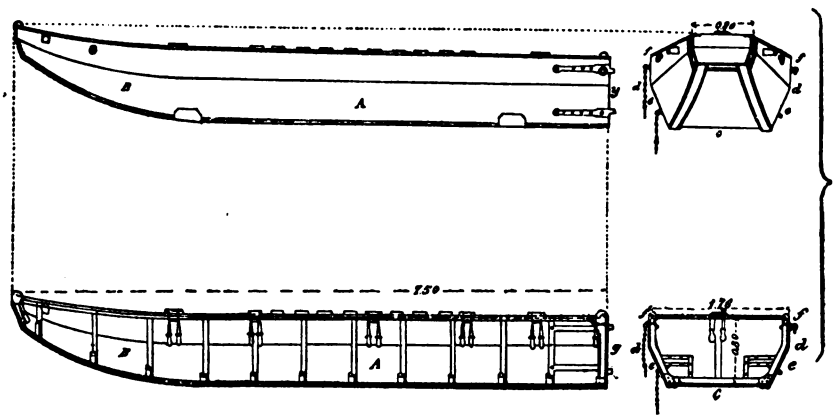

FIG. *b*.

Trestle.—Birago system, analogous to that described for the bridging sections. The transom is provided with pins fitting into holes in the baulks, of which there are six to a bay.

Transom.—Length, 5·22 m. Width at the ends, 0·21 m.; at the centre, 0·16 m. Depth, 0·23 m. Weight, 110 kg. Distance between the points of suspension, 3·40 m.

Legs.—Lengths, 5 m., 4 m., and 2·50 m. Section, 0·09 m. × 0·15 m. Weight, 42·50, 26, and 15 kg. respectively.

Suspension Chains.—Length, 2 m. Diameter of the iron, 0·013 m. Weight, 11 kg.

Shoes.—Length, 0·69 m. Width in the middle, 0·28 m. Thickness, 0·075 m. Of oak.

Saddle.—Placed longitudinally in the pontoon to support and fix the baulks. Length, 4 m. Section, 0·11 m. × 0·15 m. Weight, with pins, 35 kg.; without pins, 31 kg.

Pickets.—Of ash, iron bound. Length, 1·76 m., 1·40 m., and 1 m. Weight, 15·55, 10·75, and 5·66 kilos. respectively.

Baulks.—Without claws, and with holes into which fit the pins of the transoms and saddles. Length, 7 m. Section, 0·11 m. × 0·15 m. Weight, 60 kg. Distance of the holes from the ends, 0·10 m., 0·89 m., and 1·10 m. Length in the clear of the bays—Pontoons, 5 m.; trestles, 6·64 m.

Chesses.—Length, 3·30 m.; breadth, 0·33 m.; thickness, 0·05 m.; weight, 23·50 kg.

Half-Chesses.—Length, 3·50 m.; breadth, 0·12 m.; thickness, 0·05 m.; weight, 6·50 kg.

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Rack Lashing.—Length of rack stick, 0·70 m.; of lashing, 1 m.

Anchor.—Cast iron, of the ordinary shape; weight, 65 kg.

Oars.—Length, 4·09 m.; weight, 8·60 kg.

Boathooks.—Length, 4 m.; weight, 7 kg.

Boats.—Length, 7·75 m.; width across gunwales 1·80 m., across bottom 1·37 m.; depth at the bow 0·64 m., at the stern 0·56 m., amidships 0·41 m.; cubic capacity, 3·200 cubic mètres; buoyancy, 2,920 kg.

Grapnels.—Weight, 21 kg.

Ropes.—Anchor cable, 80·90 m. long; 0·025 m. in diameter; weight, 41 kg.

Warps.—15 m. long; 0·02 m. in diameter; weight, 4·70 kg.

Lashings.—4·75 m. long; 0·02 m. in diameter; weight, 1·60 kg.

Handrail Rope.—160 m. long; 0·02 m. in diameter; weight, 50·50 kg.

Large Anchor Cable.—100 m. long; 0·03 m. in diameter; weight, 74 kg.

Grapnel Cable.—50 m. long; 0·13 m. in diameter; weight, 7·50 kg.

Handrail Stanchions.—Of tubular iron; exterior diameter, 0·022 m.; weight, 2·20 kg.

VEHICLES.

Wagons.	Length without Pole.		Height.		Track.	Distance between the Axles.	Average Weight.		
	Empty.	Loaded.	Empty.	Loaded.			Empty.	Loaded.	
	m.	m.	m.	m.	m.	m.	k.g.	k.g.	
Pontoon and baulk (*Fig. c*)	5·75	7·80	1·41	2·52	1·50	3·50	720	2250	With pontoon.
Ditto (*Fig. d*)	5·75	7·80	1·41	2·52	1·50	3·50	720	1860	With two boats.
Pontoon and chess ...	5·75	7·50	1·48	2·59	1·50	3·50	760	2280	
Trestle or chess	4·20	5·40	1·53	2·19	1·50	2·44	725	2270	With trestles.
Ditto	4·20	4·20	1·53	1·96	1·50	2·44	725	2105	With chesses only.
Park, covered	3·52	3·52	2·25	2·25	1·50	1·92	925	2240	
Field forge ..	4·70	4·70	2·21	2·21	1·50	2·45	1123	2280	
	3·96	3·96	1·79	2·21	1·50	1·92	990	1700	

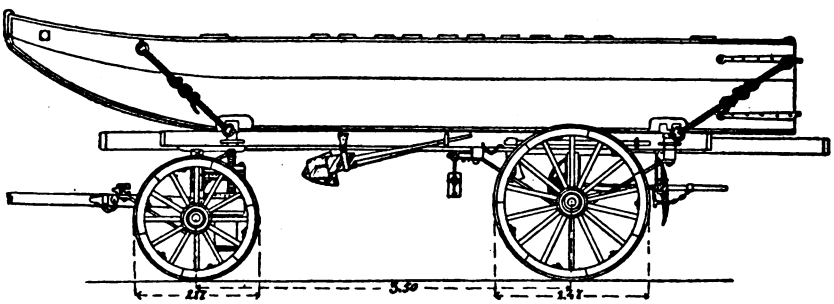

FIG. *c*.

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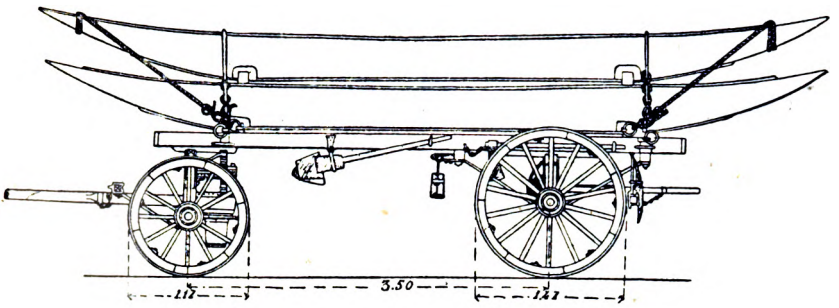

FIG. *d*.

Loads of the Vehicles.

Pontoon and baulk wagon	Baulks	10
	Pontoon	1
	Lashings	4
	Chesses	3
	Handrail stanchions	2
	Half-chesses ...	2
	Moorings... ...	1
	Anchors	1
	Anchor cables ...	1
	Oars ... 5 or	6
	Boathooks ...	1
	Baulks ... 5 or	6
	Cut baulks ...	2
	Rack lashings ...	8
	Balers	1
	Warps	2
	Boxes containing various articles.	

Boat wagon	Boats ...	2	One set packed in each boat.
	Lashings ...	4	
	Oars ...	5	
	Boathooks ...	1	
	Grapnels ...	1	
	Balers ...	1	
	Grapnel cables	1	
	Medium pickets	2	
	Ropes ...	1	
	Rack lashings	6	
	Lifebuoys ...	1	
	Tools, lead lines, etc.		
Pontoon and chess wagon	Chesses ...	22	
	Pontoon ...	1	
	Lashings ...	4	
	Empty box ...	1	

Inside the pontoon, carried on a pontoon and chess wagon, are packed:—

Chesses	3	Baulks...	5 or 6
Handrail stanchions	2	Cut baulks	2
Half-chesses	2	Rack lashings	8
Moorings	1	Balers	1
Anchors	1	Warps...	2
Anchor cables	1	Besides, in boxes, lashings, wedges, etc., etc.	
Oars	5 or 6		
Boathooks	1		

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Chess wagon

- Chesses 50
- Warps 1
- Anchors 1
- Lashings 2
- Also, in a box, entrenching tools and materials for extemporized bridges.

Field forge wagon

- Field forge, smiths' and farriers' tools.
- Horseshoes, iron, etc.
- Wuelle lamp (Wells').

Trestle wagon

- Saddles with pins 3
- Legs, long ... 2
- Saddles without pins 3
- Lashings ... 3
- Transoms ... 3
- Legs, medium ... 3
- Chesses 6
- Shoes 6
- Legs, short ... 6
- Pickets: large ... 3; medium 9; short ... 6

Trestle wagon (*cont.*)

- Suspension chains 6
- Rack lashings ... 64
- Wedges .. 4
- Lashings ... 1
- Also, in a box, entrenching tools and materials for extemporized bridges.

Park wagon

- Various articles, rope, explosives, various kinds of tools.

Transport wagon

- Stationery.
- Safe.
- Kitchen for six persons, supplies for officers, clothing and equipment, tents, tailors' and shoemakers' boxes, horse ropes and pickets, spare wheels and poles, etc.

TRACTIVE FORCE.

Applying the same principles as in the case of the French bridging train, and assuming the weight of the loaded park wagon (2,240 kg.) as the mean of all the wagons, that six-horse teams are used, that the wagon has no springs, and that the mean diameter of the wheels is 1·25 m., we obtain a coefficient of traction equal to 214.

COMPARISON OF THE FRENCH, ITALIAN, AND SPANISH BRIDGING TRAINS.

The Commission considers that the Spanish bridging material is in every way superior to the French and Italian, and that it is only in quantity of material that France and Italy have the advantage over Spain.

France possesses 4,830 mètres of bridge.
Italy ,, 3,000 ,, ,, ,,
Spain ,, 882 ,, ,, ,,

Experience has shown that an army should be provided with 8 mètres of bridge for every 1,000 men. Otherwise, extemporized bridges must be resorted to, and the time required for their construction cannot usually be spared.

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The Spanish bridging material is modern, and possesses many advantages, viz. :—(1). The latest advances in metallurgy have been utilized, sheets of galvanized steel, 1·13 mm. in thickness being used, and nearly all the metal work of the equipment is of this material. (2). A single steel pontoon, besides being lighter for its dimensions and having a greater buoyancy than a wooden pontoon, costs much less for maintenance. (3). Repairs, made in the cold, can be much more rapidly and safely effected. (4). The symmetrical shape of the pontoon makes it extraordinarily easy to manœuvre, both when in bridge and when used as a boat. (5). The trestle is a marked improvement on the Birago trestle; the ends of the transom being of steel, sliding up and down the legs is facilitated. The inclination of the legs has been reduced to the slope strictly necessary for securing lateral stability. (6). Only one type of wagon is used. (7). Almost all the elements are interchangeable. (8). The coefficient of traction, which is 187 in France and 214 in Italy, is only 162 in Spain with four-horse teams. (9). Great simplicity (10). The speed at which a bridge can be constructed with the Spanish equipment is much greater than it is in the case of the French and Italian materials.

In both France and Italy it is possible to practice bridging in rivers 200 m. or more in width, and with currents of $4\frac{1}{2}$ miles an hour and upwards. This cannot be done in Spain, as it is only during the spring, the season in which the recruits are being trained, that such rivers can be found in that country.

The Commission concludes its report by saying: "The contempt with which the great military powers treat everything that refers to Spain, alone explains the superiority which we hold over almost all of them in the matter of bridging material."

'M.'

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REVIEW.

MILITARY HYGIENE.

By Lieut.-Colonel R. H. Firth, R.A.M.C.—(J. & A. Churchill, London. 3s. 6d. nett).

In the 300 pages of this book, Lieut.-Colonel Firth has condensed a mass of information which everyone should know, but which unfortunately everyone does not. Unfortunately, because it is well known that in a campaign the losses through preventable diseases far exceed the losses due to actual fighting, and the author clearly shows that success in war depends not only in having an efficient army, but in keeping it effective. How this can be done by taking the necessary precautions—generally of a simple character—is the purport of this work, and no officer, N.C.O., or man can be said to really understand his business till he has assimilated its contents.

By an Army Order at the beginning of the year, it has been rendered compulsory for every officer to pass an examination in this subject for promotion; but this is not a matter to be crammed up to pass a certain test. It is vital to the efficiency of the Army, and every officer should be acquainted with the details with which the book deals.

Lieut.-Colonel Firth, who was for some years Professor of Military Hygiene in the Royal Army Medical College, and is now officer in charge of the School of Army Sanitation, treats the subject from the points of view of the barracks, the camp, in the field, and on the march, and one is struck with the thoroughness with which the subject is discussed, and surprised that so much has been introduced into such a comparatively small compass. As a Corps we are specially concerned with much with which this book deals, and therefore both as soldiers and technical officers we should be doubly interested in the subject.

The author is to be congratulated on the success which has attended his efforts to make things extremely clear, and the perusal of the treatise impresses one with its importance.

The illustrations are simple, the printing good, and the paper excellent, and altogether this small work will prove a valuable addition to every officer's bookshelf.

J. Winn.

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NOTICES OF MAGAZINES.

Journal des Sciences Militaires.

September 15th, 1908.

The article, on "Dirigible Balloons" is continued, the present number dealing with the possibility of their destruction by rifle and artillery fire. Infantry fire is considered to be practically harmless on account of the impossibility of setting the sights correctly, except by chance, and also on account of the very small hole made in the envelope when hit. "Experience proves that the loss of gas from a hole made by a rifle bullet, diminishes the lifting power by 7 or 8 kilogrammes at the outside The only serious damage that can be effected is by a lucky shot hitting either an aeronaut or the motor."

Shrapnel—by reason of its depth—is considered to be the artillery projectile for use against balloons. The balloon will be sheltered when 100 mètres above the highest point of the trajectory of any shrapnel. On the whole, a minimum height of 600 or 700 mètres is enough for protection from field guns. By burying the trail, a height of about 950 mètres might be attained as the highest point of the trajectory, but the mobility and rapidity of fire is reduced in consequence, and there is also a chance of the gun turning a somersault. With light howitzers of the German type, a balloon moving at 30 miles an hour, if at a height of 1,000 mètres, would be under fire for five minutes, and for 2½ minutes if 1,500 mètres up. Mountain artillery is not so dangerous as howitzers, but more so than field guns. Machine guns may be a serious danger, provided the range is known. Heavy artillery, including naval anti-torpedo-boat guns, is more dangerous than field guns. A balloon could not safely approach a ship by day except at a very great height. Range-finding is too slow, as modern methods of ranging shots are accurate enough to find a sufficiently close range. The method of fire must be salvoes of shrapnel.

An account of Austrian, Belgian, and French experiments to determine the vulnerability of captive balloons is given, and the lack of success of Japanese and Russians in bringing down balloons, is mentioned.

The conclusion arrived at is that an armoured automobile, carrying a quick-firing gun capable of 70 degrees elevation, is the best means of

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engaging dirigibles, and there is a description of an Austrian gun of this type.

The first of a series of articles on "Infantry Machine Guns" contains a description of the early types and their use, particularly in 1870. After the American Civil War glowing reports of the destructive qualities of machine guns were published by American papers, apparently with a view to getting rid of their surplus stock. The French, somewhat taken in by this, secretly built some of their own design as a surprise on the outbreak of war. They were very heavy, needing teams of four horses, and were always breaking down owing to the gun crews being unused to them. In action they were found to be quite unable to cope with artillery fire, but when protected from it, did good service more than once in defending posts against infantry. Their moral effect was very great. The Bavarians had one battery, which only arrived towards the end of the war, and was of great use at Coulmiers. In consequence of their experience both countries decided against using machine guns in the field.

Gatling guns were used by the Russians at Plevna, by the Chilians in Peru, and in our Egyptian Campaign. They were used essentially on the defensive, and had great effect especially on undisciplined troops.

One of a series of articles on the Russo-Japanese War appears in this number, the particular subject being machine guns. Though neither side had many of these guns on the outbreak of war, both largely increased their stock. The Japanese had 200 and the Russians 23 eight-gun companies at the end of the war. The Japanese guns at the end of the war were attached to regiments in groups of two to six. At the Yalu the eight Russian machine-guns checked at first the turning movement of the Japanese right, silenced a battery, and helped to secure the retreat.

An account of a Russian company's experience at Liao-Yang is given from the *Invalide Russe*. The company checked the enemy's advance, and held its position for two days, finally retreating after suffering heavy loss from artillery fire. It was impossible to reply to this owing to the range. At Mukden two machine-guns, attached to the section occupied by the 164th Regiment, prevented the Japanese from reaching the village occupied by this corps, and according to Capt. Niessel, all accounts agree as to their great moral and material value. Although especially suitable for the defensive, they can be very useful on the offensive, as they can render support to the infantry by approaching nearer than is possible for the more vulnerable artillery. They are very useful for pursuit or repulsing counter-attacks. Attached to cavalry, they give it an offensive power previously unknown, and cyclist companies are much strengthened by them.

The criticism on the Franco-German War is on the events from August 7th—12th.

The "Campaign in Styria" gives an account of the operations of Broussier's division about Gratz from June 21st to June 25th.

H. L. WOODHOUSE.

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JOURNAL OF THE MILITARY SERVICE INSTITUTION (U.S.A.).

September—October, 1908.

This number contains no article of which one can say "Here is something really good and new, let me call attention to it"; but many of its pages are noticeable because they contain passages which with very little alteration might have been written for ourselves. This is specially remarkable in Major Foote's honourably mentioned essay on "The Military Necessities of the United States," as, for instance:—

"The military history of the United States, from the earliest settlement of the colonies down to within the past ten years, has been marked by a lack of adequate preparation for even a defensive war. Over 300 years' war with the Indians, resulting in the conquest of the vast territory comprised within our present boundaries, was replete with massacres, defeats, and failures, due to insufficient preparation. . . . But whether successful or not at the outset, the tenacity of our people has enabled them to triumph in the end over all foes, domestic or foreign. So that we look complacently upon the future, believing that, whatever comes, we are sure to succeed eventually, even though we may suffer defeat and humiliation in the beginning." The essay generally is a plea for thorough preparation in time of peace, and the author thinks he can detect a change in public opinion since the Spanish War, which is leading to "a more adequate recognition of our military necessities and a more efficient preparation for national defense."

The author's peroration to his appeal for improved coast defence is suggestive to those who care about the balance of power in the Pacific:—"We cannot rest easy until the Pacific Coast defenses of both mainland and inlands are completed and supplied, the Pacific fleet strengthened, and the Panama Canal opened." On p. 177 there occurs a passage which might have been written for England, but, unfortunately, we enjoy no "isolation" geographically:—"Our traditional reliance in war is upon volunteers, and owing to our isolation from other great nations, our people vaguely rely upon raising and setting on foot a sufficient number of Volunteers before any power would have time to land a large army on our soil. This idea, vague though it may be, amounts to a settled condition, and there is no use in running counter to it or trying to get around it. The people rule, and we must bow to their will." It will doubtless surprise many to learn that the United States, of all countries, foresee the possibility of invasion from over the seas, and are taking steps to guard against it.

Here is another sentence that ought to set us thinking, with reference not only to our home-defence forces, but also to our native Indian Army:—"No matter how enthusiastic and patriotic a people may be at the beginning of a war, there sooner or later comes a time in a protracted war when volunteering practically ceases." This might almost have been written with reference to our experiences at the time of the Boer War,

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and the following remark gives an American appreciation of conscription. Senator McDougall in 1862 said:—"Now, in regard to this conscription question, I will say, for myself, that I regretted much, when this war was first organized, that the conscription rule did not obtain. . . . I found some districts where some bold leaders brought out all the young men and sent them, or led them, to the field; in other districts—and they were the most numerous—the people made no movement toward the maintenance of the war; . . . The whole business has been unequal and wrong from the first. The rule of conscription should have been the rule to bring out men of all classes and make it equal throughout the country." In connection with this subject also it is instructive to read that "The conscription laws of the Civil War, passed in time of war, met with fierce criticism and objection, and their enforcement in some places was accompanied by violence and bloodshed," and many will agree with Major Foote when he says how necessary it is "to make familiar to all of us the nature, extent, and method of imposition of an obligation which may require a man to suddenly leave his business, sever home ties, and risk life itself." Among the author's more detailed recommendations may be mentioned his scheme for officering a large levy of volunteers by drafts from the active list of the Regular Army; senior captains and junior majors to become Volunteer colonels, other officers of field rank to become Volunteer brigadiers, etc. He lays great stress on the necessity of having well-trained officers, and recommends that Volunteer regimental officers should have special instruction in camp for 10 days annually. Their camp life is to be so like "the real thing" that "it is thought best for the Government to furnish rations for the officers, with the idea of familiarizing them with it, they to live on the ration in camp and superintend the seeking of it, or, if they choose, seeking it themselves." The discomfort (to put it mildly) of a sudden drop from three, or more, meat meals a day to rations pure and simple is a very real one in the case of all amateur soldiers and also of many Regular officers, as they would soon realize if the same practise obtained in this country.

Two other papers in this number touch on matters concerning the officer. In "Readjustment of Rank" Colonel C. J. Crane champions the regimental as opposed to the general-list system of promotion. Apparently the crack regiments are suffering from a block at present which would be relieved by a modification of the regimental system. The author, who has received quick promotion in a black regiment, protests.

Capt. C. D. Rhodes supplies a study of "How Best to Instruct Officers of our Army in Tactics," which has been read at the Army Staff College (U.S.A.), and is now published "as treating of a subject of vital interest and importance to the Army." His chief recommendations consist in the institution of well-equipped military libraries at all stations, and constant exercise in tactical problems both on the map (including war games) and on the ground (including manœuvres); so it cannot be said that he suggests anything very new to us. The following, in connection with instruction,

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not examination, reads oddly:—"The consensus of opinion is held that map-problems . . . should be marked, not on a numerical scale, but simply as 'excellent,' 'good,' 'poor,' 'unsatisfactory,' or the like." This points to a school-masterly frame of mind among the military instructors of the U.S. Army, which happily is very rare in our service; but it is only fair to Capt. Rhodes to acknowledge that he does consider it imperative that faults and preferable dispositions should be indicated in some manner. Two sentences are worth quoting. They follow the expression of a pious hope that American soldiers may display a "more certain degree of tactical skill and intelligence" than their predecessors, and are as follows:—

"At any rate, we may hope not to stumble through our future wars in that hit-or-miss fashion which has characterized the past, trusting in the grace of God and the proverbial luck of the United States.

"And hand in hand with our tactical development we must strive to educate the American public to a realization of our military unpreparedness and tactical shortcomings, considering in its entirety that *greater* American army upon which we must depend in time of war."

The concluding portion of an essay on "Small Arms Ammunition Supply" is the only other article of more than local interest in this number.

T.F.

REVUE DU GÉNIE MILITAIRE.

August, 1908.

CALCULATIONS FOR STRAIGHT BEAMS.—A method of finding the stresses in a loaded beam. The following are some of the results arrived at:—

Let AB be a beam of length a supported at A and B, the end at A being fixed. If the beam is uniformly loaded with w pounds per foot, the reaction at A will be $\frac{5}{8}wa$, and at B $\frac{3}{8}wa$. The bending moment at A will be $\frac{wa^2}{8}$. If both ends are fixed, the reactions will of course be equal, and the bending moment at either end will be $\frac{wa^2}{12}$.

Again, let AB be a beam resting freely on three supports at A, B, and C, and let the lengths of AB and BC be a and b respectively. Then the reaction at A will be $\frac{3a^2+ab-b^2}{8a}w$, at B $\frac{(a+b)(a^2+3ab+b^2)}{8ab}w$, and at C $\frac{3b^2+ab-a^2}{8b}w$.

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If the beam is fixed at A and C, the reaction at A is $\frac{4a^2+ab-b^2}{8a}w$, at B $\frac{(a+b)^3}{8ab}w$, and at C $\frac{4b^2+ab-a^2}{8b}w$. The bending moment at A is $\frac{2a^2+ab-b^2}{24}w$, and at B $\frac{2b^2+ab-a^2}{24}w$.

The reactions and bending moments are also calculated for beams resting on four, five, and six supports. As the number of supports is increased, the reaction at each intermediate support approximates to the total weight on one span.

THE FOREIGN MILITARY ESTABLISHMENTS IN CHINA.—A continuation of the previous articles. The writer considers that all the Japanese arrangements indicate their intention of making a long stay in the country. A short description is given of the various Italian barracks, but these call for no special mention.

J. E. E. CRASTER.

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CORRESPONDENCE.

VERTICAL SUNDIALS.

SIR,

In the August number of the *R.E. Journal* Lieut. Dunman gives the ordinary method of computing the hour-lines of a horizontal sundial. The formula may, for convenience, be written

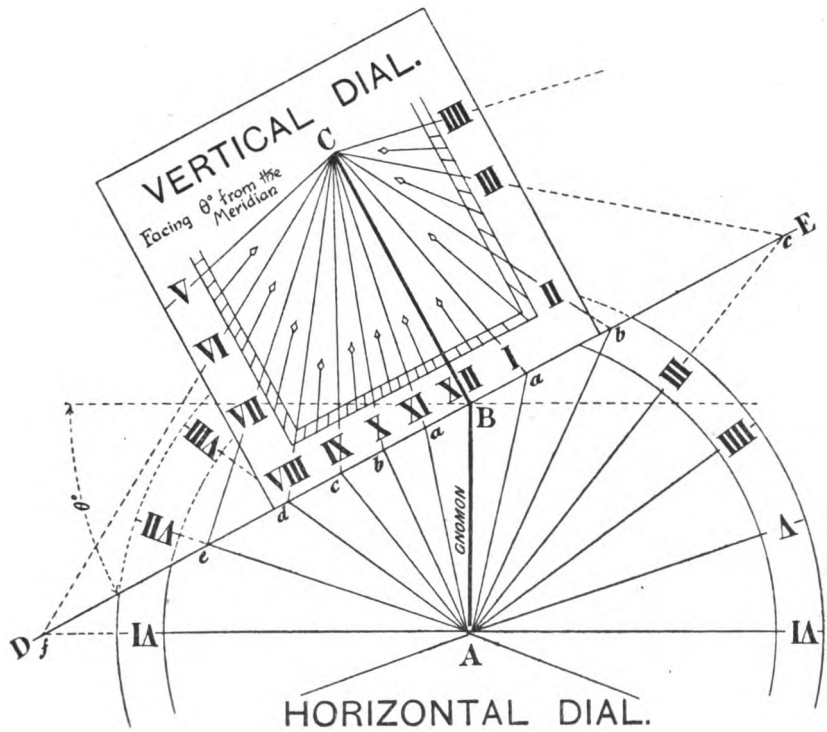
$$\tan X = \sin \text{latitude} \times \tan (H \times 15) \quad \text{..... (i.)}$$

where H is the number of hours after or before noon, and where X is the angle with the meridian made by the shadow of the Gnomon at H hours.

For a vertical dial facing due South in Northern Latitudes, or due North in Southern Latitudes, the formula becomes

$$\tan Y = \cos \text{latitude} \times \tan (H \times 15) \quad \text{..... (ii.)}$$

where Y is the angle with the vertical.



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But in practice it is often desired to fix a vertical sundial to a wall which does not face exactly South (or North in Southern Latitudes), and, as I have been unable to find information in any text-book as the method of arriving at the hour-lines in such a case, I venture to hope that the method described below may be of service.

First draw a horizontal dial, the hour-lines being calculated from formula (i), and in the drawing let AB be a plan of the Gnomon (taking any convenient length).

Suppose the aspect of the proposed vertical dial to be $\theta°$ East of South; then through B draw DBE, making an angle $90° - \theta$ with the meridian and cutting the horizontal hour-lines in *a*, *b*, *c*, *d*, etc.

Set up BC at right angles to DE, making BC:AB = tan latitude. Join C with *a*, *b*, *c*, *d*, etc.

Then C*a*, C*b*, C*c*, C*d*, etc., are the required hour-lines of the vertical dial.

The correctness of this method will at once be apparent if the drawing be folded along the line DE until the vertical dial is in a vertical position for, since by construction BC:AB = tan latitude, the folded paper represents a combined horizontal and vertical dial, having the Gnomon ABC common to both faces; and the shadow lines must take the direction A*a*C, A*b*C, A*c*C, A*d*C, etc.

For those who prefer to compute the angles mathematically, the formula for a vertical dial facing $\theta°$ from the meridian is

$$\tan Y = \frac{\sin X}{\tan \text{ latitude} \times \sin (90° - X + \theta)} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(iii.)}$$

where X has the same value as in (i.).

In all vertical dials the plane of the Gnomon must of course correspond with the meridian, and the sloping edge must, as in the case of horizontal dials, make an angle ϕ with the horizontal plane, where ϕ is the latitude of the place.

J. B. MACGEORGE,
Capt., R.E.

The Editor, *R.E. Journal.*

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A FEW PRESS (and other) OPINIONS.

The Editor in *The Nation in Arms*, the Official Journal of The National Service League, in writing to the Editor of "Defenders of Our Empire," under date of July 31st, 1908, states:—"He is very much struck with the quality and form of the new Publication."

The Morning Post, July 31st, 1908, says:—"A handsome new Quarterly has made its appearance, entitled 'Defenders of Our Empire,' and edited by Mr. C. Gilbert-Wood."

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,, E. M. Birch, D.S.O., Royal Field Artillery.
,, P. W. Game, Royal Horse Artillery.
,, and Brevet Major C. B. Thompson, Royal Engineers.
,, R. Ommanney, Royal Engineers.
Lieut. G. P. Dawnay, M.V.O., D.S.O., Coldstream Guards.
Capt. W. Drysdale, Royal Scots.
,, G. H. B. Freeth, D.S.O., Lancashire Fusiliers.
,, R. S. Allen, Lancashire Fusiliers.
,, B. H. Chetwynd-Stapylton, Cheshire Regiment.
Capt. A. Crookenden, Cheshire Regiment.
,, and Brevet Major I. Stewart, Scottish Rifles.
Lieut. H. Needham, Gloucestershire Regt.
Capt. E. R. Clayton, Oxfordshire Light Infantry.
,, J. C. H. Newman, Essex Regiment.
,, L. A. E. Price-Davies, V.C., D.S.O., King's Royal Rifle Corps.
,, W. E. Davies, Rifle Brigade.
,, L. R. Vaughan, Indian Army.
,, J. Brough, Royal Marine Artillery.

The following Officers received nominations:—

Capt. the Hon. C. H. C. Guest, 1st Dragoons.
,, and Brevet Major E. D. Lord Loch, M.V.O., D.S.O., Grenadier Guards.
,, R. H. Mangles, D.S.O., Royal West Surrey Regiment.
,, H. W. Grubb, Border Regiment.
,, G. N. Cory, D.S.O., Royal Dublin Fusiliers.
,, G. D. Bruce, Indian Army.

WOOLWICH, NOVEMBER, 1907.

THIRD	F. N. M. Mason ... 7,441	27th	H. W. Crippin ... 6,411
FIFTH	E. J. Moorhead ... 7,236	32nd	L. H. King-Harman ... 6,372
SIXTH	C. W. R. Tuke ... 7,166	35th	R. B. Pargiter ... 6,339
24th	J. R. Pinsent ... 6,493		

This is the second time in two years we have passed THREE out of the first SIX for Woolwich.

SANDHURST, NOVEMBER, 1907.

12th	C. W. Maxwell ... 5,172	27th	C. T. Ellison ... 4,912
13th	R. C. Money ... 5,169	38th	B. C. H. Keenlyside ... 4,644

CAVALRY, NOVEMBER, 1907.

7th ... A. M. Sassoon ... 3,481

WEST INDIA, NOVEMBER, 1907.

SECOND ... F. T. Hughes ... 4,331

INDIAN POLICE, JUNE, 1907.

THIRD	F. W. Toms ... 6,886	27th	H. W. Waite ... 5,980

ARMY QUALIFYING, MARCH, 1908.

Six were successful from us.

MILITIA COMPETITIVE, MARCH, 1908.

Douglas Scott, Kent Artillery.
D. G. Gunn, 3rd P.W.O. West Yorkshire Regiment.
A. L. Cooper Key, 5th Middlesex Regiment.
W. C. Loder Symonds, Lancashire Field Artillery.
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THE ROYAL ENGINEERS JOURNAL.

Vol. VIII. No. 6. DECEMBER, 1908.

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10. **THE RUSSO-JAPANESE CAMPAIGN UP TO THE BATTLE OF LIAO-YANG.** By Capt. SEDGWICK, R.F.A. [*Shortly.* (This Campaign is set for all Military Examinations in May and November, 1909).

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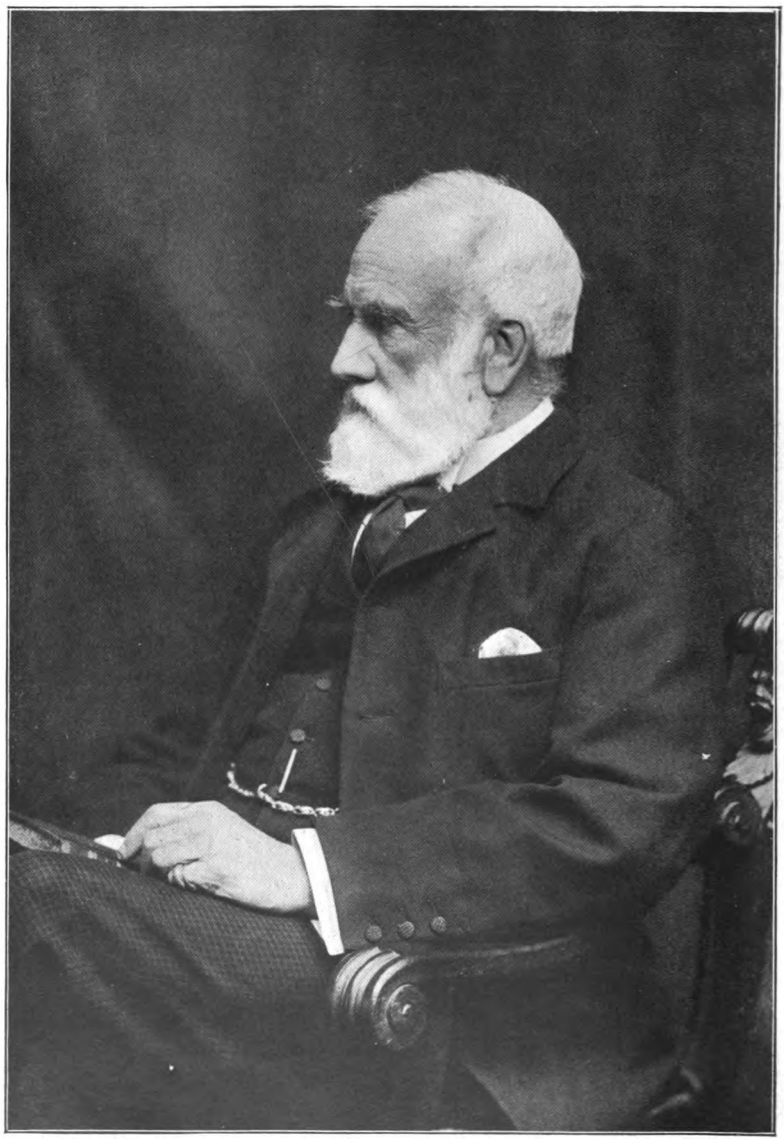

General F. H. Rundall, C.S.I., R.E.

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REPORT ON ELECTRO-PNEUMATIC AND AUTOMATIC RAILWAY SIGNALLING INSTALLATION ON LONDON & SOUTH WESTERN RAILWAY.

By LIEUTS. G. C. V. FENTON AND W. G. TYRRELL, R.E.

AUTOMATIC signalling has not been widely adopted in the railways of Great Britain, although many hundreds of miles are in operation in the United States of America.

Electro-pneumatic signalling on the system of the British Pneumatic Signal Co., Ltd., is installed on the London and South Western Railway at the following places:—Staines Station and Triangle Junction; Andover and Grateley (inclusive); Salisbury Station; Basingstoke (inclusive) to Woking Junction (exclusive).

In this system compressed air is the power used to move points and signals. Electricity is used to control the compressed air between stations, and to a limited extent in stations.

Compressed air is supplied by steam-driven air compressors, situated at Fleet, Andover, Salisbury, and Staines. There are auxiliary compressors at Woking, Basingstoke, and Grateley (oil engine drive), which would only be used in case of breakdown to the other plant.

The ordinary types of stop and distant signals are used. The distant signals are fitted with the Coligny Welch Distinguishing Distant Signal Lamps, which show ordinary red and green lights by night, and in addition, on the right-hand side, as seen by drivers approaching them, an illuminated fish tail, showing by night a white light (see *Fig.* 1).

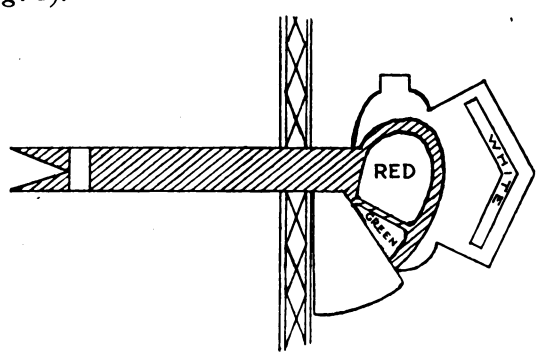

FIG. 1.

All the signals are placed on specially constructed signal bridges spanning the lines referred to. The signals are thus placed directly

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over the line to which they refer, avoiding any confusion which exists under the old system of placing fixed signals by the side of the line.

Fig. 2 is a diagrammatic representation of the down-starting signals at Farnborough Station. *Fig.* 3 represents the up-starting signals at Winchfield Station.

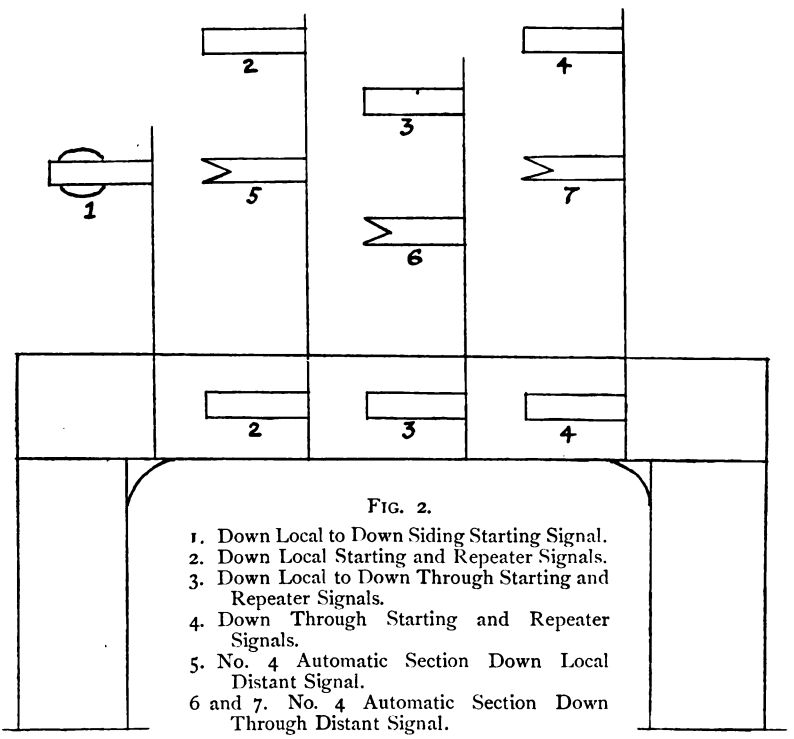

FIG. 2.

1. Down Local to Down Siding Starting Signal.
2. Down Local Starting and Repeater Signals.
3. Down Local to Down Through Starting and Repeater Signals.
4. Down Through Starting and Repeater Signals.
5. No. 4 Automatic Section Down Local Distant Signal.

6 and 7. No. 4 Automatic Section Down Through Distant Signal.

Fig. 4 represents the signal bridge on the London side of Pirbright Junction signal box. *Fig.* 5 (see *Plate*) shows the position and arrangement of all signals from the up side of Winchfield Station to the up side of Farnborough Station. *Fig.* 6 (see *Plate*) shows the arrangements between Farnborough and the up side of Pirbright Junction. Whenever there are points to be moved, such as junctions, crossovers, and turnouts into sidings, there must be a signal box to control the points and the signals in the immediate vicinity.

All signals worked from boxes are normally at danger, and are shown thus in *Figs.* 5 and 6. Between stations, *i.e.*, where there are block sections, in which there are no switches, the signals are worked automatically by the trains. The signals at the beginning of any of these sections only go to danger to protect the train while it is in that section, the normal position being "off." Each automatic home

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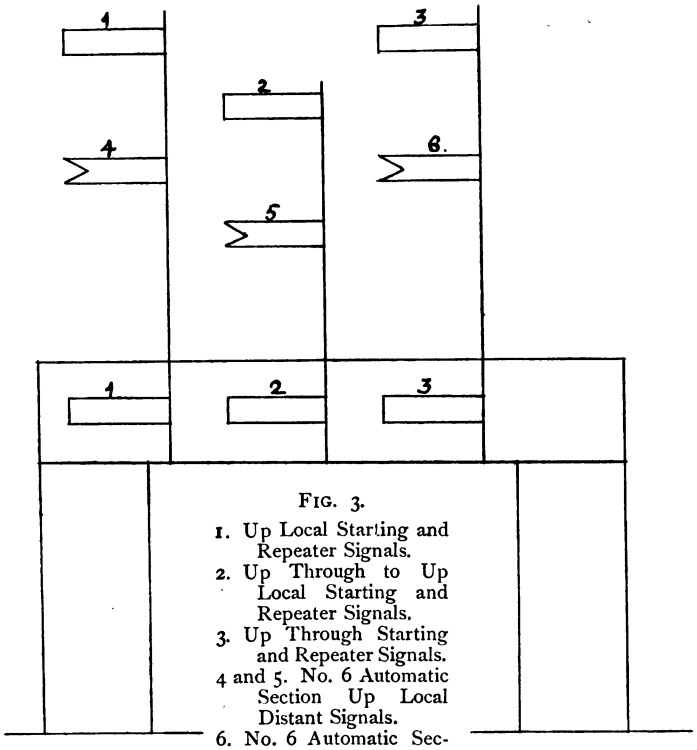

FIG. 3.

1. Up Local Starting and Repeater Signals.
2. Up Through to Up Local Starting and Repeater Signals.
3. Up Through Starting and Repeater Signals.
4 and 5. No. 6 Automatic Section Up Local Distant Signals.
6. No. 6 Automatic Section Up Through Distant Signals.

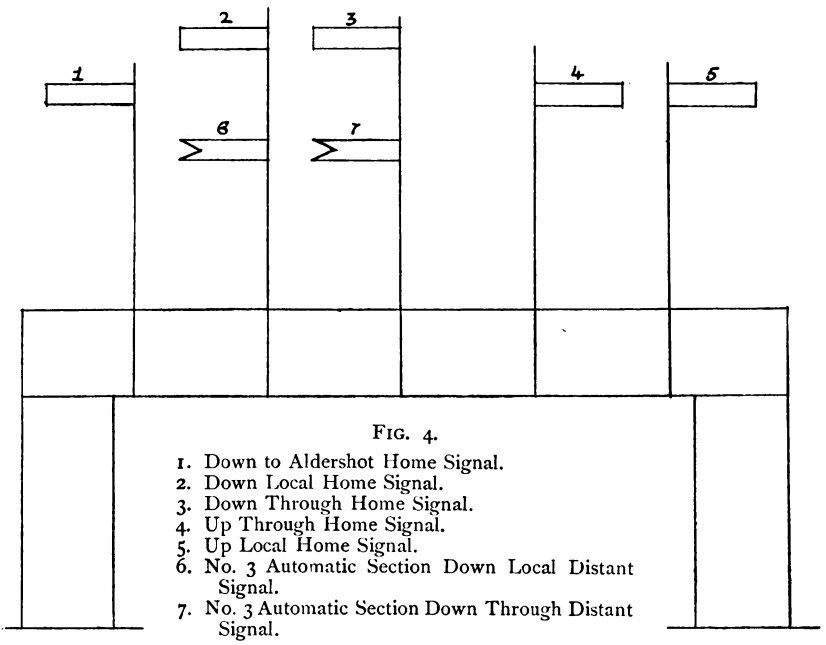

FIG. 4.

1. Down to Aldershot Home Signal.
2. Down Local Home Signal.
3. Down Through Home Signal.
4. Up Through Home Signal.
5. Up Local Home Signal.
6. No. 3 Automatic Section Down Local Distant Signal.
7. No. 3 Automatic Section Down Through Distant Signal.

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signal has its corresponding distant signal on the first signal bridge in rear. A distant signal cannot be in the "off" position when the home signal above it is at danger.

The most noticeable difference between manual and power installations is in the equipment of the signal boxes. The results of both systems, as far as the movement of signals and switches is concerned, are the same, but the means of accomplishing these results are different, and the difference is most apparent in the signal boxes. The row of long levers, which are universal in manual-worked boxes, is replaced by a number of small handles, which take up very little room, and are very compact, thus being completely under the eye of the signalman. The physical exertion on the part of the signalman is, in this, as in any power system, reduced to a minimum.

The handles in the pneumatic-worked boxes perform the same function as the levers in the manual-worked boxes. For the sake of consistency, and to avoid confusion, the name lever is retained. In manual boxes the mechanical interlocking is always placed horizontal and under the floor. In a pneumatic box the parts of the interlocking are much smaller, but of the same construction, and the interlocking frame is placed vertical, in front of the frame which supports the levers.

Every signal box has a large scale diagram showing the position of all switches and signals, and also a table showing the mechanical and electrical interlocking.

Every lever has, on a plate, the numbers of levers which must be moved before it. As examples, a signal for a crossover could not be pulled off until the points had been moved to the right position, and the plate on the signal lever would bear the number of the point lever; a distant signal lever would have on its plate the numbers of the home and starting signals.

The distant signals controlled by a box are usually so far away that they cannot be seen. An indicator is therefore provided in the box which shows the position of the distant signal by means of a miniature distant signal arm.

Indicators, with miniature semaphore arms, are also provided to show the state of the line for both approaching and departing trains as far as the next signal box on either side. The section working the indicator is, in each case, from a box starting signal to a box home signal. The danger position of the miniature arm indicates that a train is on the line, and the "off" position that the line is clear.

A Board of Trade regulation requires that audible and visual warning should be automatically given of the approach of a train, in accordance with which the indicator for approaching trains is provided with a bell (a different tone for each indicator), which rings when the arm goes to the danger position.

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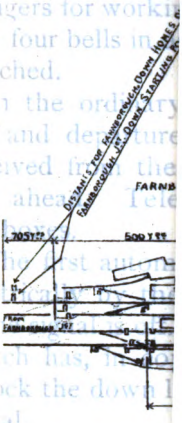
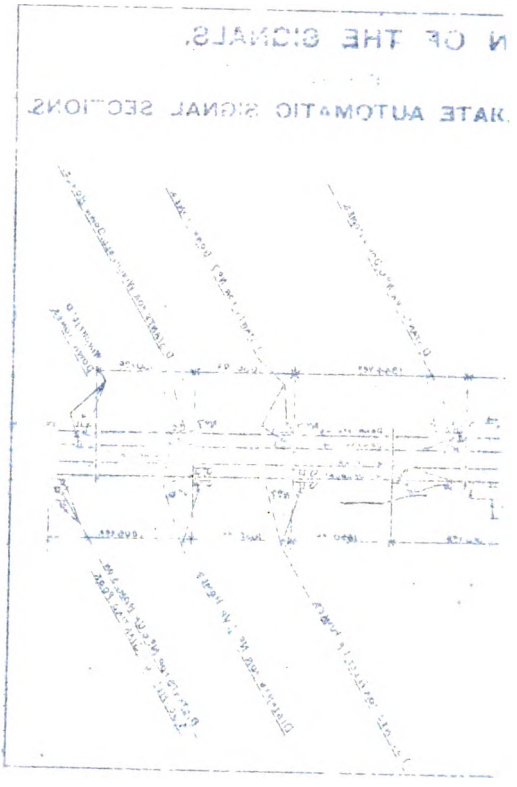
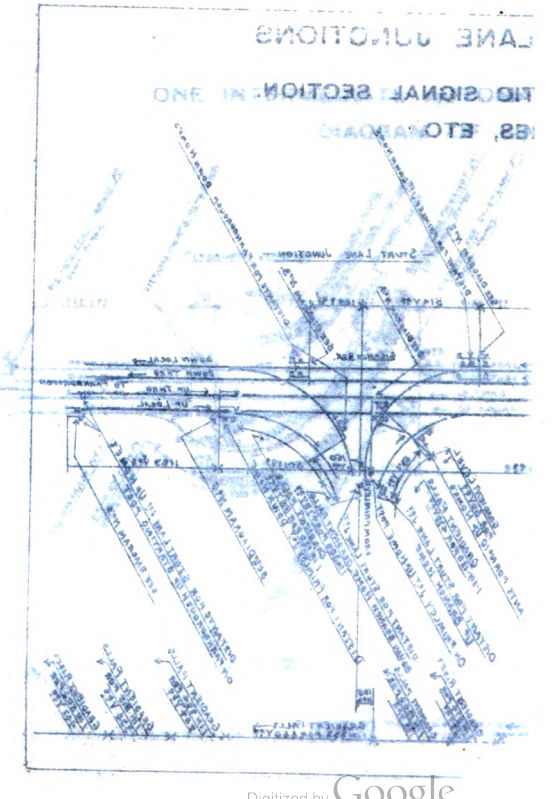


FIG. 5.





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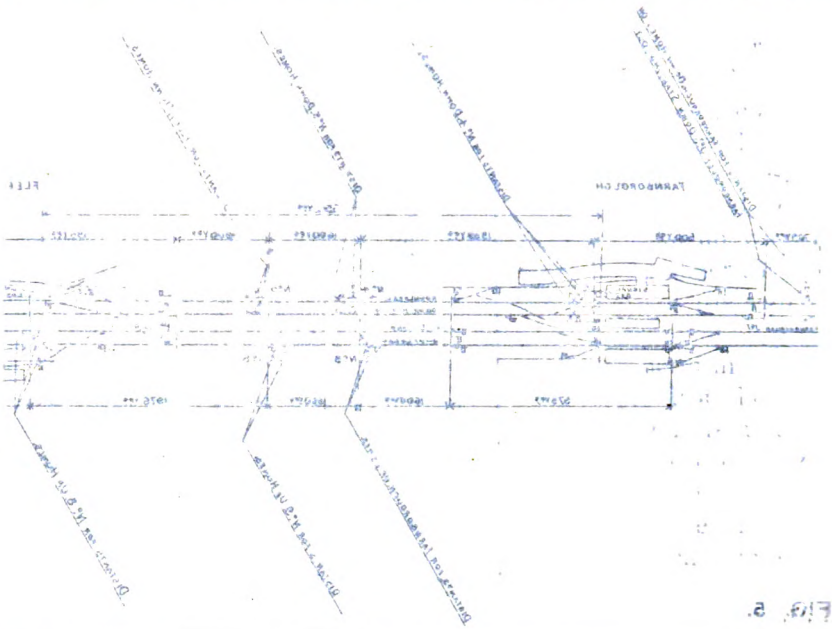

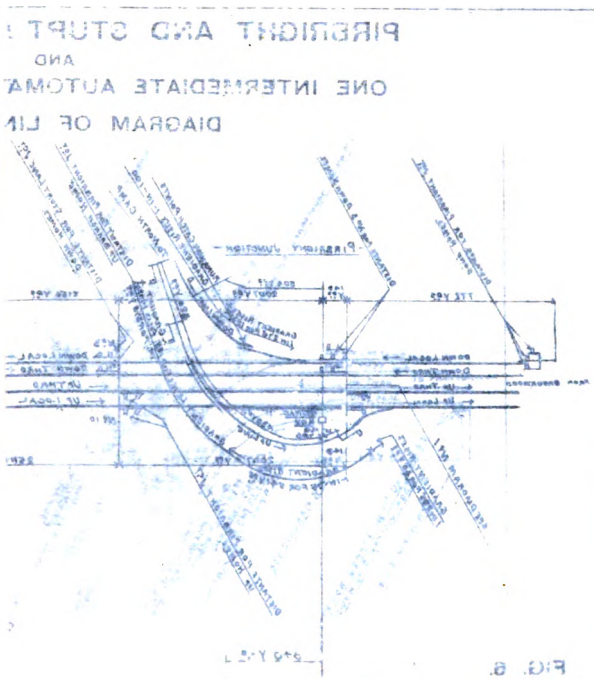

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Electric-bell signals are provided between boxes, one bell for each pair of up and down lines. There are two bells each way and two plungers for working those in the adjacent boxes on a four-track road. The four bells in a box have different tones, so that they need not be watched.

In the ordinary working (electro-pneumatic system) only warning and departure signals are sent. When a departure signal is received from the box in rear, the warning signal is sent to the box ahead. Telephonic communication is also provided between the boxes.

The first automatic signal outside a box home signal is controlled electrically by the home signal, and may not come off unless the home signal is off. This causes delay at certain times, and an electric switch has, in consequence, been placed in the Sturt Lane box to unlock the down local automatic signal immediately outside the home signal.

The system of the British Pneumatic Signal Co. is called the low-pressure system. The pressure used to move switches and signals is 15 lbs. per square inch. Air at this pressure is controlled by relay valves, which are worked by air at 7 lbs. pressure.

The signals on automatic bridges are moved by air at 10 lbs. pressure. The pressure in the distributing mains is 80 lbs. per square inch.

The chief characteristic of the low-pressure pneumatic system is the diaphragm valve (see *Fig.* 7). It is operated from the signal box by air at 7 lbs. pressure. This raises the diaphragm, which is 8 inches in diameter, and allows air at 15 lbs. pressure to pass through the valve as shown by the arrows. The lowering of the diaphragm closes the supply and opens the exhaust. The diaphragm only requires to be raised $\frac{1}{4}$ inch. As this valve performs a similar function to an electric relay, it is called a relay valve, and will be denoted in diagrams by the letter R.

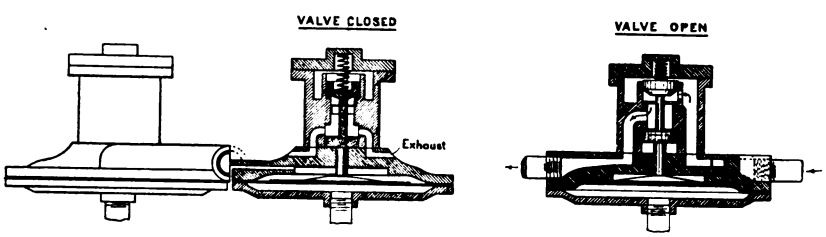

FIG. 7.—*The Double Diaphragm and Valve.*

The cylinders for operating switches are 10 inches in diameter, those for signals 5 inches in diameter, and the air pipes from the box to the switches and signals are $\frac{1}{2}$ inch in diameter.

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Fig. 8 is a diagram showing the arrangement of pipes, etc., for operating a switch and indicating back to the box that the switch is in the desired position. The principal parts are :—

S. Switch rails.
s. Switch rod.
sl. Lock rod.
M. Motion plate.
C. Switch cylinder.
D. Indicating valve.
R2, R3, R4, R5. Relay valves.
L, L2. Operating bar and slide valve.
I, I2. Indicator cylinders.
H. Interlocking tappet.
X. High-pressure air supply, 15 lbs. per square inch.

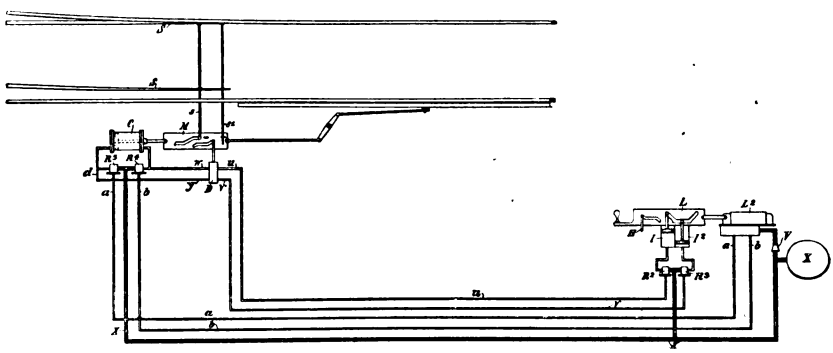

FIG. 8.—*Diagram of Switch and Lock Movement.*

To move the switch the signalman pulls L out until the top of the piston I2 comes up against the shoulder in the slot. L2 moves at the same time and admits air at 7 lbs. pressure from X through the reducing valve V to pipe *a*. This acts on the relay valve R5, which admits air at 15 lbs. pressure to the left-hand end of the switch cylinder C, and moves the piston and motion plate completely over to the right. The movement of the motion plate is divided into three parts. The first part moves the indicator valve D, closing communication between W and U, and removes the stud from lock rod *sl*, but does not move the switch rod *s*. The second part moves the switch by means of the rod *s*, but does not move the indicator valve. The third part of the movement can only take place if the switch is properly closed and the slot in *sl* is opposite the stud. The indicator valve is at the same time moved farther across and opens communication between *y* and *v*. This allows air from R5 to travel through *dyv* to R3, which admits air from supply X to cylinder I2. The piston I2 is raised, and by means of the inclined slot forces L and L2 through the remainder of the stroke. This indicates to the signalman that

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the points have been moved and locked. The movement of L2 opens *a* to exhaust, thereby lowering the valve in R5, which cuts off the supply from X to C and exhausts C*dyu*. This makes R3 act similarly and exhausts air from I2. There is now no pressure in any of the pipes. The movement of H effects the proper mechanical locking.

To move the switch back again the lever is pushed in until stopped by piston rod I. Air is admitted to *b*, and the switch is moved by air in the other set of pipes in a similar manner to that described.

Fig. 9 is a diagram showing the arrangement of pipes, etc., for operating a signal. The principal parts are :—

A. Signal arm.
A2. Operating cylinder.
B. A connection from pipe *n*, which is open to the cylinder when the piston is at the bottom.

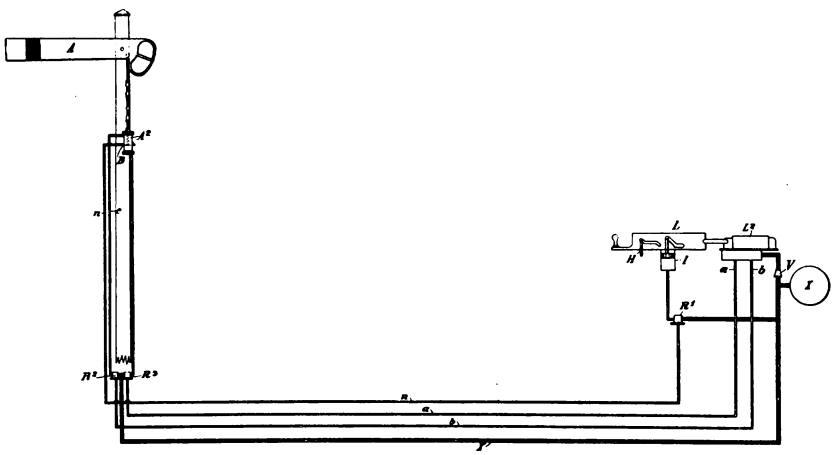

FIG. 9.—*Diagram of Semaphore Movement.*

The remaining parts are lettered as before. When the signal is moved to the danger position the completion of the movement is indicated as with a switch. It is not considered necessary to indicate that the signal is in the off position, as it does not jeopardize the safety of a train. Only one indicating pipe and one indicating cylinder are therefore necessary.

To lower the signal, L is pulled the whole way out and moves L2. Air at 7 lbs. pressure is admitted to *a* and works R3. This admits air at 15 lbs. pressure to the bottom of A2. The upward movement of piston A2 brings the arm to the "off" position, where it remains as long as L is kept out. To replace the signal L is pushed in until stopped by the top of piston rod I. The accompanying movement of L2 opens *a* to exhaust. This affects R3, which closes the supply

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of air from X and exhausts the air from under A2. The same movement of L2 admits air to *b*, which acts on R2 and admits air from X to *e* and the top of A2. This restores the signal to the danger position. When the piston reaches the bottom of the cylinder air is admitted through B to pipe *n* and operates valve R1. This admits air from X to I, raises piston I and moves L through the remainder of the stroke. L2, being moved with L, opens *b* to exhaust, and through valves R2 and R1 exhausts pipes *e* and *n* and cylinder I.

Where two or more roads lead off a single one great economy in space and pipes can be effected by working all the signals off one lever and using a selector valve attached to the switch. Which signal is lowered will then depend on the position of the switch.

In *Fig.* 10 signal 1 refers to the left-hand road and signal 2 to the right-hand road. The selector valve is attached to the switch indicator valve, and joins AD or AC according as the switch is set for the left or right-hand road. With the switch set as shown in the

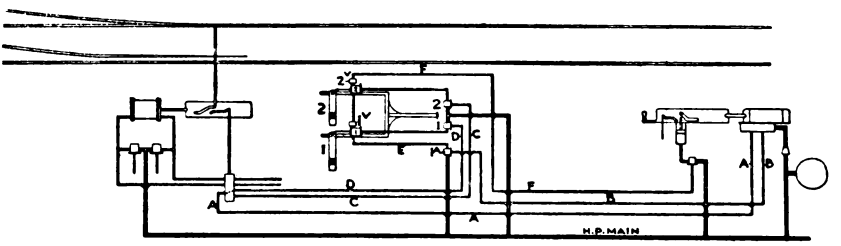

FIG. 10.—*Diagram of Selected Signal.*

diagram, A is connected to D, as shown by the dotted line. On pulling the lever, low-pressure air is admitted to AD and works relay valve 1, and causes signal 1 to come to the "off" position. On replacing the lever the air is exhausted from AD and from the underside of cylinder 1. At the same time low-pressure air is admitted to B and acts on relay 1*a*. The relay admits high-pressure air to E and the top of cylinder 1. When the signal has returned to the danger position the air passes through indicator valve 1^v to cylinder 2, through indicator valve 2^v and pipe F to the relay under the replacing cylinder, and causes the lever to complete its stroke. Air is then exhausted from B, E, and F as in ordinary working. The object of the indicating air passing through both signal cylinders and indicator valves is to indicate that both signals are at danger, which is the only indication which is of any use in this case.

The next point to consider is the employment of track circuit in conjunction with the pneumatic working of switches and signals.

The sequence of events will be as follows :—The signalman lowers a signal to admit a train to an unoccupied section; the train, on passing the signal, replaces the lever in the box and causes the signal

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to resume the danger position; the lever is now held locked, and cannot be pulled to allow another train to enter the section until the *whole* of the train now occupying the section has left it.

The principal additional articles necessary to effect this are the relay, the electro-pneumatic valve, and the electro-pneumatic cut-off valve.

The relay consists of an electro-magnet placed in the track circuit. When energized it attracts an armature to which a contact is attached, and causes it to close a secondary circuit. When the track circuit is broken or otherwise interrupted the secondary circuit is broken.

The electro-pneumatic valve consists of an electro-magnet, to the armature of which a valve is attached. When the magnet is energized air is admitted through the valve, otherwise it is closed.

The electro-pneumatic cut-off valve is similar in construction, but opposite in action. When the magnet is energized the valve is closed, otherwise air is allowed to pass through the valve. When these valves are closed the outlet pipe is open to exhaust.

Fig. 11 is a diagram showing the arrangement which enables a train to return a signal to danger without the intervention of the signalman. The additional apparatus is :—

ER. Electrical relay.
M. Electro-pneumatic cut-off valve.
C. Replacing cylinder.
IB, IB1. Insulating joints at each end of the section.
TB. Track circuit battery.
K. Circuit breaker for secondary circuit.

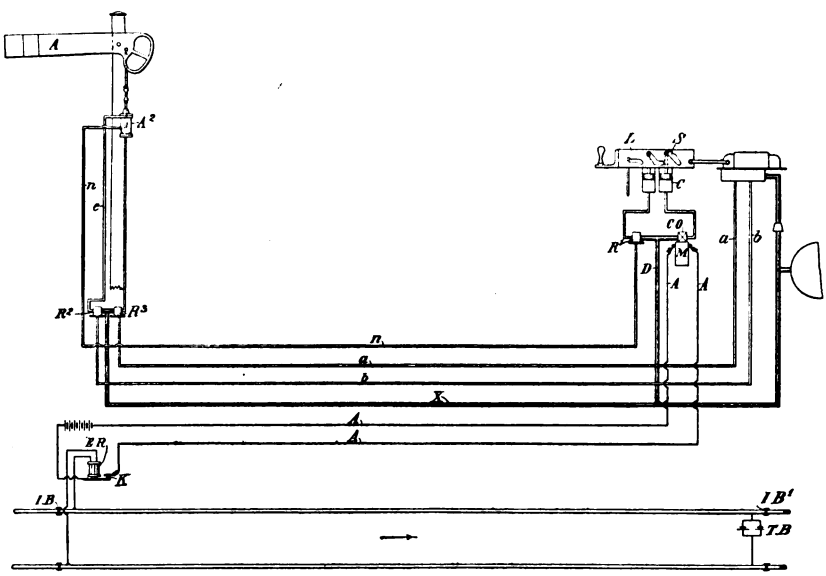

FIG. 11.—*Diagram of Replaced Signal.*

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The signal is lowered to admit a train as described before. The signal being in the "off" position, a train approaching from the left passes the joint IB and short-circuits the battery TB. This de-energizes the relay ER, and the secondary circuit through A is broken. This de-energizes the magnet of the cut-off valve, and air is admitted from X to C. The piston C being raised moves the lever to the right, until the top of the piston rod comes in contact with the shoulder in the slot S. Air is now admitted to pipe *b*, and the signal and lever are replaced as before described. As long as the train is in the section the air is held in the cylinder C, which, by means of the shoulder in slot S, holds the lever in the normal position. When the train leaves the section both circuits are completed and C is exhausted, allowing the top of the piston rod C to fall below the shoulder. The signal may now be pulled "off" for another train.

Fig. 12 shows the arrangements for automatic working in stations. When it is desired to close a signal box at night, through lack of

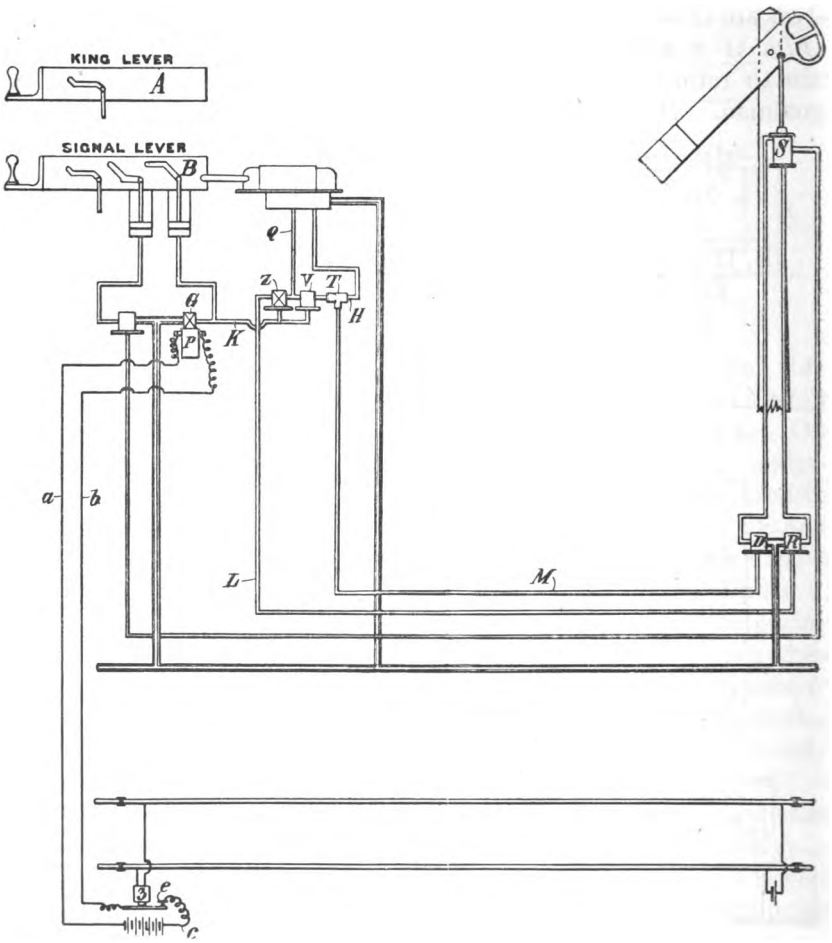

FIG. 12.—*Automatic Station Signal Working.*

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work necessitating the movement of switches, the signals may be made to work automatically without increasing the length of the sections. In order to close a manual-worked signal box the two adjacent sections must be thrown into one.

To work automatically all the roads are set for through running and the signals pulled. The king lever is then pulled out and locks all the signals in the "off" position by means of mechanical interlocking. On a train entering the section from the left the relay 3 is de-energized, and the secondary circuit broken at *e*. This de-energizes P and allows air to pass through the cut-off valve G to cylinder B. As the lever is locked in the "off" position B is unable to act, and the air passes to Z and V. Z is a cut-off valve, which now closes the passage of air from Q to L and exhausts the air from the underneath side of the cylinder S by way of pipe L. At the same time the relay valve V admits air from Q to the slide valve T, which cuts off M from the exhaust through H, and allows the air from Q to enter M and act on relay valve D, thereby causing the signal to return to danger. When the train leaves the section, relay 3 is energized, circuit *abc* is made, and magnet P is energized, which by working valve G exhausts the air from under cut-off valve Z and relay V. Air is now admitted through Z to L, and M is exhausted through T to H, due to V being closed. This affects relays D and R, so that the air is exhausted from the top of cylinder S and let in at the bottom, which brings the signal to the "off" position.

Fig. 13 shows the electro-pneumatic valve; *a* is the air supply, *e* the outlet to work, and *d* the exhaust. When the magnet M is energized the armature A and rod *r*, with valves *v*1 and *v*2 attached, are raised. This closes the exhaust from *e* through *c* to *d*, and allows air to pass from *ab* to *e*. In the normal condition (*i.e.* de-magnetized) air cannot pass from *ab* to *e*, and *e* is open to exhaust through *c* to *d*.

Fig. 14 shows the electro-pneumatic cut-off valve.

This valve is opposite in its action to the previous one. When the magnet is energized air cannot pass from *ab* to *e*, and *e* is open to exhaust through *d*. In the normal position (*i.e.*, demagnetized) *e* is cut off from the exhaust through *d*, and air can pass *ab* to *e*.

Fig. 15 shows a portion of a line signalled by the electro-pneumatic automatic system. The line is divided into sections or track circuits by placing insulated joints, J1, J2, J3, J4, at the entrance to each section. The abutting rails in each section are joined together at the joints by bonding wires to make the circuit continuous. Each track section is provided with a track battery of two cells in parallel. The batteries are connected to the rails at the end of the section farthest from the signals. For each section there is a relay R1, R2, R3, R4, connected to the rails at the entrance to the section. The relay, when energized, closes the main circuit at A1, A2, A3, A4. Each semaphore arm is provided with an electro-pneumatic valve as

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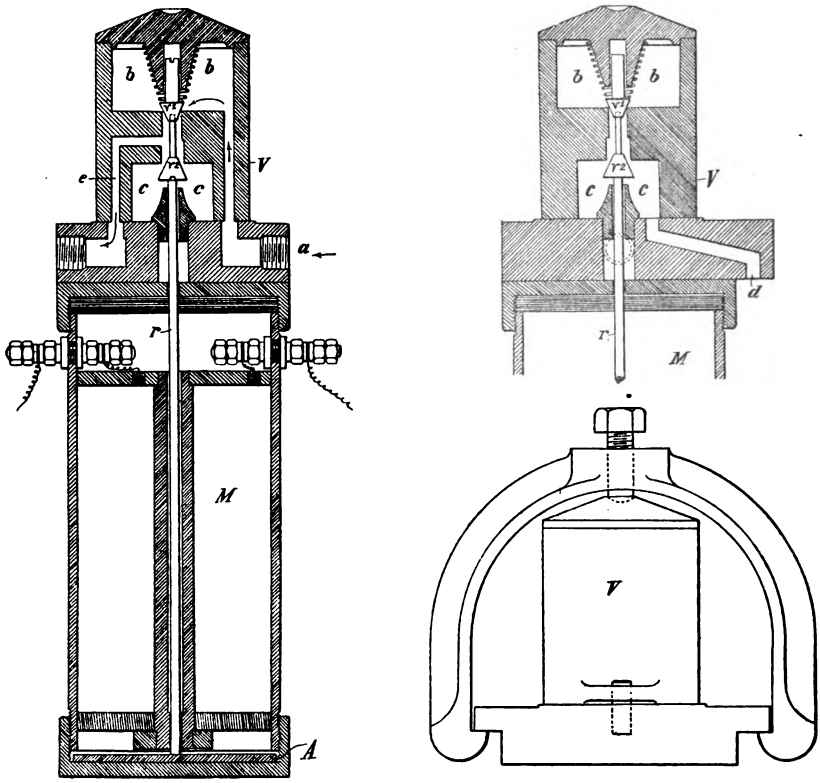

FIG. 13.—*Electro-Pneumatic Valve.*

already described. When the magnet is energized the valve admits air at 10 lbs. pressure from a reservoir to the operating diaphragm which lowers the signal. When the air is exhausted the signal goes to danger by gravity. The air supply for the reservoir is taken direct from the main pipe through a reducing valve.

Each distant signal valve magnet is in a circuit from the main battery which operates the corresponding home signal. Each of these circuits has two circuit breakers in it, one of which is attached to the home signal which is above the distant signal on the same post, and the other to the home signal next in advance (*i.e.*, the home signal to which the distant refers).

The two circuit breakers worked by a home signal close the circuits when the home signal is at safety and break them when at danger.

Suppose a train, represented by a pair of wheels and an axle X, to have entered Section 3. Battery B3 will be short circuited and relay R3 de-energized. This breaks the main circuit from B8 at A3 and de-energizes the electro-pneumatic valve M6, and causes the home signal to go to danger, as already explained. When the home signal

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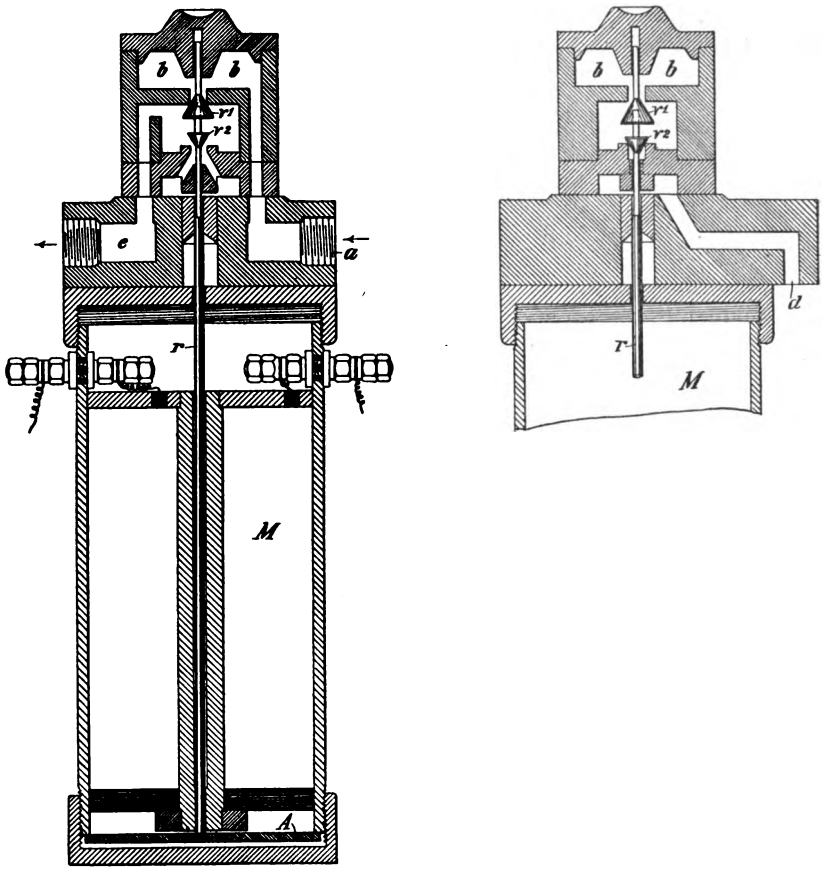

FIG. 14.—*Electro-Pneumatic Cut-off Valve.*

goes to danger the contacts C6 and C5 break the circuits in which they are placed. This causes the magnets of valves M5 and M3 to be de-energized, and the distant signals on posts 3 and 2 go to danger.

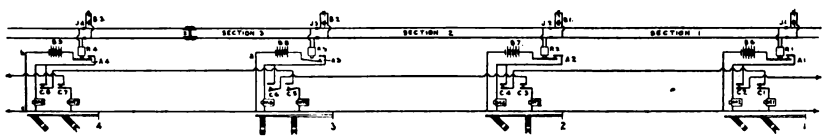

FIG. 15.

When the whole of the train has left the section the broken circuits are re-established, and home signal 3 and distant signal 2 go to the safety. In the meantime home signal 4 has gone to danger to protect the train, and opened circuit breakers C8 and C7. This keeps distant signal 3 at danger and causes distant signal 4 to go to the danger position.

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Fig. 16 shows on a larger scale the mechanism for working the automatic signals. The following are clearly shown :—

Insulated joints. Shown J1, J2, J3, J4, in *Fig.* 15.
Track and main batteries—B3 and B8.
Relay and circuit breaker—R3 and A3.
Electro-magnetic valves—M5 and M6.
Electrical connections to circuit breakers C5 and C6 on home signal.
Main air pipe.
Reducing valve.
Diaphragm operating valves.
Rods from above to signals.

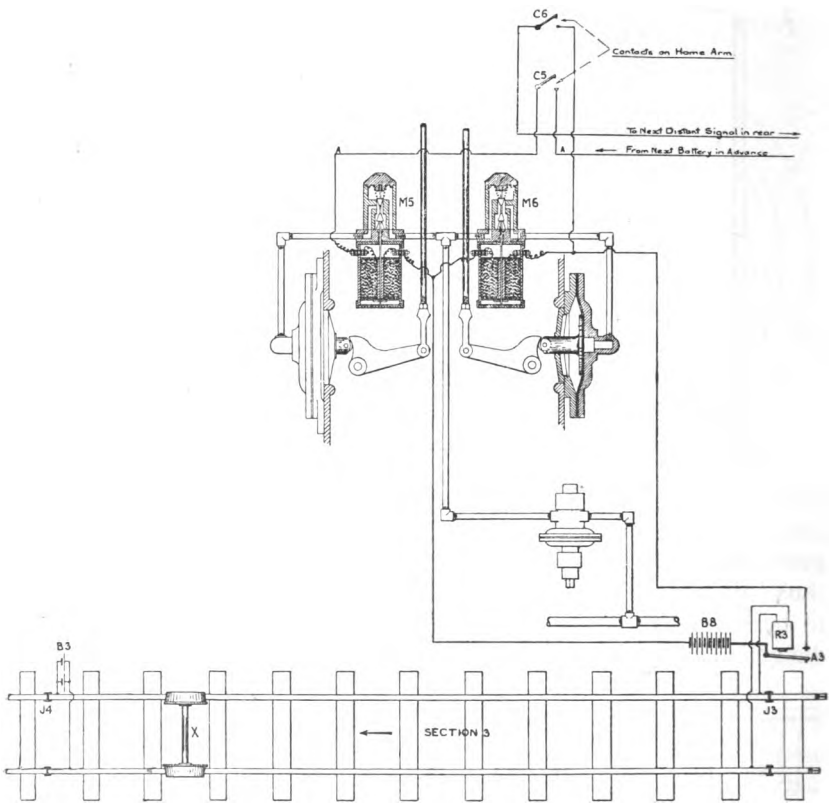

FIG. 16.

Having described the working of the electro-pneumatic signalling, it now remains to discuss the advantages and economies of the installation. The first point of economy is in the wages of signalmen, as it is claimed that one signalman can do the work of three, and all the manual labour in connection with intermediate blocks between stations is done away with by using the automatic bridges. From

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the mechanical point of view it is a great advantage, as all rods and wires are abolished, and replaced by underground pipes, which does away with all danger to officials moving about the line, and also reduces the wear and tear of moving parts to a minimum. The train movements can be effected much more rapidly by means of the pneumatic system than by any manual plant, and the physical labour required of the signalman is practically negligible. The automatic indication also relieves him of considerable mental strain, and he is thus less likely to be overcome by fatigue during long hours.

There are six characteristic features in this system—

(1). It requires no force but air.
(2). The air pressure is always low, being normally 15 lbs. per square inch.
(3). Every movement is accomplished by air pressure and quite independent (except on automatic bridges) of gravity, springs, or withdrawal or reduction of pressure.
(4). Except when a switch or signal is being moved or an indication given, all operating and indicating pipes are subject to atmospheric pressure, and no more.
(5). The final portion of the stroke of the "lever" is automatic, requiring no effort or care on the part of the operator.
(6). Signal levers, which are replaced by track circuits, are automatic for the whole return stroke and require no attention from the signalmen for this portion of the operation.

The system fulfils completely and economically the three chief functions of a railroad switch and signal device.

(1). To provide *power* to move the switches or points and signals.
(2). *Concentration* in one cabin of control, all switches and signals in a given field.
(3). Interlocking of the controlling parts of different switches and signals, so that it is impossible to give conflicting signals.

There is a marked advantage over the "all electric," owing—

(1). To the primary cost being less.
(2). The electric current required to work the signals is small, and in fact is not sufficient to ring an ordinary electric bell.
(3). The batteries required are of very simple pattern, and any person of ordinary intelligence can look after them and maintain their efficiency.

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Also over high-pressure systems—

(1). There is no possibility of trouble from condensation of moisture in pipes.

(2). Annoyance from leaks is practically abolished.

(3). A smaller quantity of air is used, thus making the service of the compressor less.

(4). The action is quicker (this advantage having been found from actual tests, with high and low-pressure pipes).

(5). If any extra power is required to make any movement or indication, an extra 50 per cent. of pressure can be introduced without increasing very materially the pressure in the pipe.

(6). If any alterations have to be made or a fault occurs, the end of the pipe can be easily closed by a block of wood driven in, all without shutting off the compressor or main source of supply.

Safety is assured in this system, owing firstly to the fact that all signals are held at the "all clear" position by pressure of air in the pipes, and, should any fault occur, the signal automatically goes to the stop or danger position by gravity. Also the passing of a train automatically sends the signals to the "stop or danger positions," and thus does away with the dangerous effect of negligence on the part of the signalman forgetting to return his signal to danger, which is possible on the ordinary lever system; thirdly, on the track all instruments are on closed circuit, and any failure in the electrical conductor or battery will put the signal on that circuit to danger, and retain it in that position until the defect is remedied.

We are indebted to the courtesy of the British Pneumatic Railway Signal Company, Ltd., for the details of working and arrangement of the system and diagrams illustrating the same.

APPENDIX I.

SPECIAL INSTRUCTIONS FOR INTERMEDIATE AUTOMATIC BLOCK SIGNALLING SECTIONS ON L. & S.W. RAILWAY.

When a driver finds an automatic home signal at danger, he must, if the signal be not lowered in the interval, wait at that signal three minutes, and after arrangement with the guard of the train, proceed cautiously, at a speed not exceeding 5 miles an hour, as far as the next home signal, and keep a sharp look-out, being prepared to stop clear of any obstruction.

o o o o o

A telephone is provided in a box, which may be opened by a carriage key, on the down line side in close proximity to each automatic signal bridge, and each instrument is connected to the station-to-station circuit.

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AIR IN WATER PIPES.

By Capt. P. H. Kealy, R.E.

Dagshai is a hill station in the Himalayas situated about 20 miles from Kalka at the foot of the hills, and 40 miles from Simla; it contains accommodation for over a battalion of British infantry, in addition to some 70 families.

The prevalence of enteric fever in the station for some years past, caused the question of the water supply to be considered in 1897. Up to that time the supply had been derived from two springs situated on the Dagshai Hill itself, about 500 feet from the top, distribution of the water being effected by means of mules. One spring, which was situated just below the native bazaar, was especially liable to contamination. In 1897 the Government of India sanctioned a scheme for an entirely new water supply. Under this scheme, three springs were to be acquired about 5½ miles to the north of the station. These springs, known as Chobal, Jobal, and Kaitree, had been used chiefly for irrigation, and for "cooling babies' heads."* The relative positions of the new springs to each other and to Dagshai are as shown.

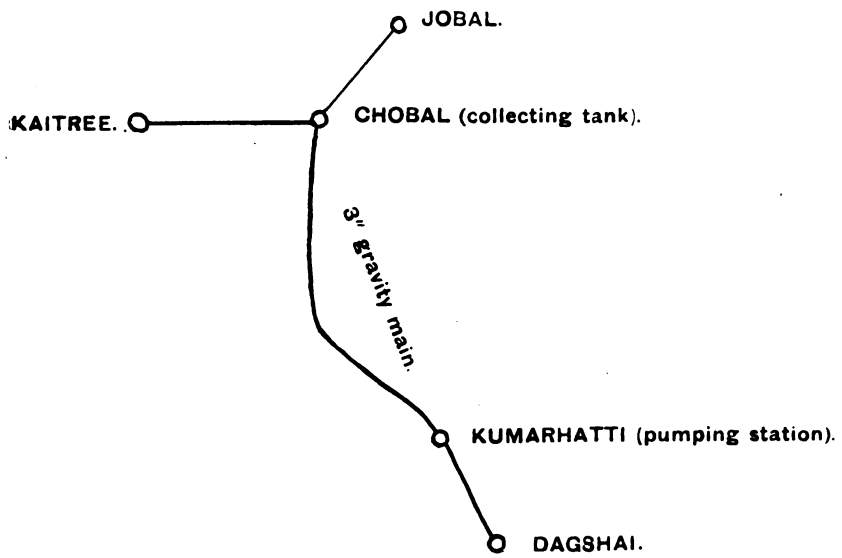

Fig. 1.

* This is the term actually used in the report, and describes a means of putting babies to sleep, which is peculiar, I believe, to the Simla Hills. It consists in placing the baby in a recumbent position, with a small stream of running water flowing on its head; the effect is found to be very soothing.

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The water was to be collected at Chobal—the nearest spring—run in by gravity to the foot of the Dagshai Hill—known as Kumarhatti—and from there pumped up into reservoirs at the top of the hill, from which it would be distributed by gravity.

This project was carried into effect in 1898. The safe minimum yield which could be counted on from the springs, is given in the report to the project as 28,000 gallons in the 24 hours, and as far as I can ascertain, the springs have never dropped as low as this since the installation has been started. But whilst there has always been a sufficiency of water at the springs for the needs of the population of Dagshai, it has not always been possible to provide a sufficiency of water at the end of the gravity main at Kumarhatti, so that sometimes Dagshai has had to go short of water, and a good deal of trouble and anxiety has been caused to those in charge of the supply.

It is the behaviour of this gravity main which may prove of interest to those dealing with similar systems of water supply.

A section of the main is shown below. The main is of 3-inch cast-iron pipes, with spigot and socket joints.

DAGSHAI WATER SUPPLY.

Section from Chobal Spring to Pumping Reservoir, Kumarhutti.

Scale—Horizontal, 1,727 Feet=1 Inch.

,, Vertical, 133 Feet=1 Inch.

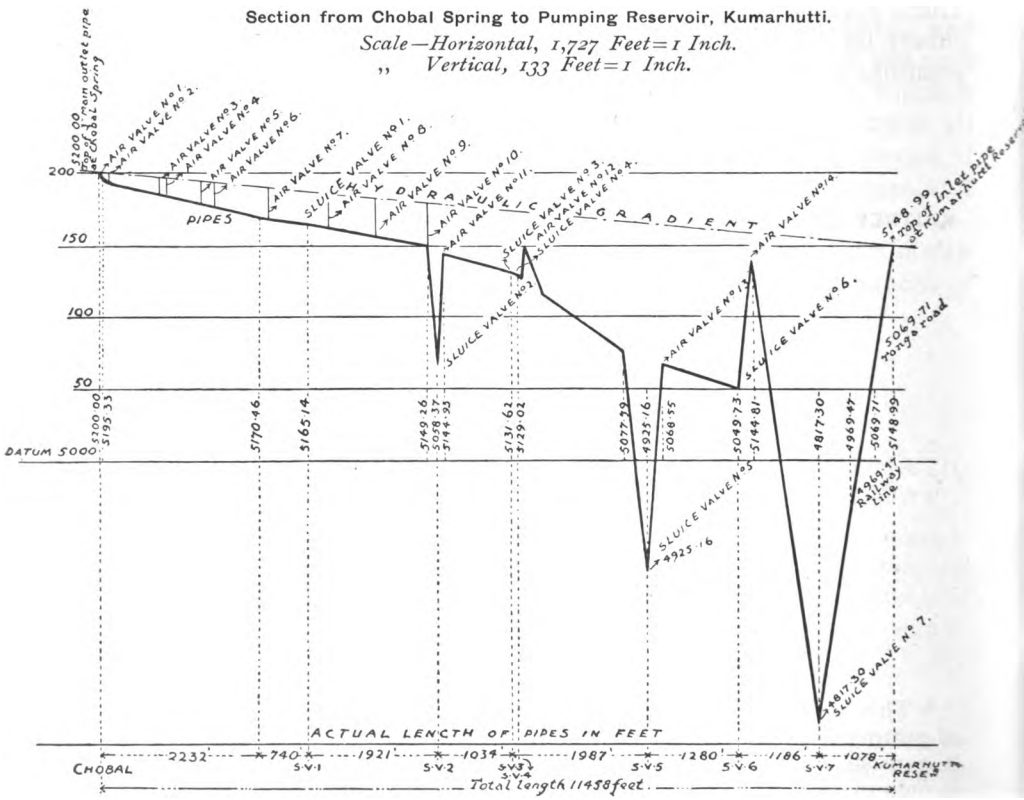

FIG. 2.

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The inflow which the pipe should give at the Kumarhatti reservoir is about 31,000 gallons in the 24 hours, calculated by Fanning's formula. The records of the inflow at Kumarhatti go back to July, 1900, and from these it is found that about April or early May each year, the inflow has started dropping below the normal flow and becoming irregular; and this in spite of there being sufficient water at the springs for the main to run at its full capacity. In 1904 and 1905 things became so bad that serious inconvenience was felt in Cantonments. Consequently in 1905, it was decided to duplicate the 3-inch main during the ensuing cold weather, so as to ensure a sufficient supply reaching the pumping station at Kumarhatti. The records of the flow along the double main for part of 1906 and 1907, again showed a diminished and irregular flow at the same time of year.

The chief explanation of the trouble lies in the air in the pipe. The pipes are laid 3 feet deep, but the line follows a devious course on the sunny side of the hill. The water at Kaitree and at the collecting tank is very much aerated, and this aeration always increases with the increase in temperature, and the decrease in the yield of the springs, *i.e.*, about April and May. The line when laid was provided with air valves at the usual and obvious points, numbered 11 to 14 on *Fig.* 2. During 1902 and 1903 the log kept at Kumarhatti shows a regular inflow of 36,000 gallons daily; but this does not represent the true state of affairs, as this flow was only obtained after frequent washing out of the line and adjustment of air valves, and for short periods only during the day. During the hot weather in 1904–05, the question was complicated by the heavy incrustation which took place in the main. This further accentuated the air trouble, so that several times the inflow of water at Kumarhatti reservoirs ceased altogether. When this occurred it was necessary to carefully wash out the line by means of the sluice valves until the air had been got rid of. In 1905, 3,000 feet of the line, which appeared to be the worst portion as regards incrustation, were taken up, cleaned, and relaid. The work on the rest of the line was undertaken during the winter 1905–06, and by 13th April, 1906, the whole of the old line had been taken up, cleaned, and relaid, and a second 3-inch main had been laid alongside the old line in the same trench. On opening out both lines it was found that all available water was being carried to Kumarhatti, which satisfactory state of affairs lasted till May 5th, when a sudden drop in both lines and an overflow at the collecting tank proclaimed a return of the air trouble. This was located chiefly between the collecting tank and No. 1 washout, and it was decided to insert some air valves in this length, two spots being selected where a rise of a few inches in the line had been noticed when relaying. The form of air valve adopted consisted of a length of ½-inch pipe, screwed into a hole bored in the 3-inch pipe, and carried up vertically some feet. It was evident that the right

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spots had been selected, as on piercing the 3-inch pipe there was an escape of compressed air for some five minutes. Another valve was also put in near the collecting tanks, these valves being the present Nos. 2, 5, and 7. The effect of these measures was to raise the supply at once from 44,000 to 56,000 gallons. After May 24th the flow was regular till the springs began to drop, all available water being carried from May 24th onwards till the rains broke, and the full capacity of the pipes was reached on July 1st. It was hoped that trouble with the line was now ended, but disappointment awaited us when on April 7th, 1907, air in the line was again the cause of anxiety. The only hope of remedy seemed to be in increasing the number of air valves between the collecting tank and No. 1 syphon. As there were apparently no more even slight rises in the line, it was decided to put in more valves, similar to those already provided the previous year, at sharp bends and at the head of the syphon. This was done with irregular results, till April 27th, by which time it had been discovered that the ½-inch pipes had been carried up too high, and that owing to this there was a column of water formed in each pipe, which prevented the proper escape of air. The height of the hydraulic gradient was accordingly found in each pipe which had been inserted, and the pipe was then cut down to within 6 inches or 1 foot of this point. A cap was also given to each pipe, and from that date the ½-inch pipes have discharged the air freely, and all available water has been carried by the mains. The new valves inserted during 1906 and 1907 are numbered 1—10.

The records for 1908 show a *steady* fall in the flow, corresponding to the drying up of the springs—which have been unusually low this year owing to bad rainfall—all available water has been carried, and it appears as though the air trouble has been solved. The water however being so hard, incrustation will probably cause further trouble and a diminished flow shortly.

From the experience gained on this line, it would appear necessary to take account sometimes of a series of sharp horizontal bends in a pipe line, as well as of vertical ones, with a view to the provision of air valves, and where the conditions are suitable the cheap ½-inch pipe used as above described forms an efficient substitute for a more expensive arrangement.

The pipes would act still better as air valves, if it were arranged, when laying the main, to provide a slight rise at the points where it was intended to insert an air valve.

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HOME DEFENCE.

By COLONEL S. A. E. HICKSON, D.S.O., R.E.

IN his article on Coast and Home Defence in the November *Journal* Colonel Reynolds appears for the most part to concur with me, though questioning whether infantry is not more important than artillery for mobile coast defence. My excuse for asking for a further brief hearing is a desire to prevent the confusion of arguments I have used with opinions, or the application of special instances as universal principles. It is always permissible to use an extreme case to enforce an argument, but this does not make the extreme case a universal one. I offer therefore the following further observations for the consideration of those interested in the coastal branch of home defence.

(1). In the national division of labour for home defence it is primarily for those whose homes are on the coast to prevent, if possible, the enemy from landing on those coasts. They are themselves our real fixed defences. If we can get them out of the homes in which they are now fixed to man even fixed guns, that will be at least one step in advance. If they can be sufficiently trained to act on the outbreak of war as semi-mobile troops, whether artillery or infantry, so much the better. My endeavour has been to show that though fixed guns may be required in special cases, such as Folkestone or Torquay, a more or less mobile coast defence should be aimed at.

(2). A better gun, of small calibre, for coast defence purposes than the modern 18-pr. and 15-pr. field gun converted it would be difficult to find. Anchored, and firing direct from the coast, or anywhere else, their fullest possible value is obtained. They are, in fact, practically fixed guns, as well as mobile. Half-a-dozen men manning one of these guns would command some 6 miles of coast far more effectually than could the same number of infantry alone. It is true that the guns must have infantry as escorts, but this does not make infantry without guns as effective as infantry with them.*

(3). I concur with Admiral Close, who, writing to the *Morning Post* on September 2nd, observes that the landing of a raiding or invading force is far more likely to be effected in small steamers than in boats. Whether against such small steamers or larger transports, artillery would be the more effective weapon. At the same time there are evidently cases where machine guns and rifles, in the hands

* Which is more truly mobile tactically—a gun commanding an arc of 6 miles extreme measurement or a rifle commanding, say, 2 miles?

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of men who can move quickly about, would be invaluable, and they are no doubt a necessity in support of the guns.

(4). Colonel Reynolds says : "The curse of fixed defences is that they render so many men immobile." Sufficient distinction however does not seem to be made between "fixed defences" and "fixed guns." The forts on our land fronts are fixed defences, but fixed guns cannot be used there. Strictly, fixed guns can only be used on the coast, where defence works of the nature of field fortifications are generally sufficient. The distinction is important, as the cost of land forts of the Port Arthur type is, out of all proportion, large as compared with the cost of coast batteries for fixed guns.

Finally. The danger of raids lies in surprise owing to steam power, the short distance to be covered, and the numerous coastal bases available to our enemies. Unless therefore there are trained territorial troops in sufficient numbers all along our exposed coasts, the concentration of a sufficient number at a given point in time to resist a landing and overcome it on the coast would be extremely difficult, if not impossible, to effect.

If we turn to history we find that in 1539, we were able to call up so many trained men in the south-east of England that the Austrian Emperor of that day thought better of his projected invasion from Dunkirk, and dispersed his armaments. The French Ambassador, Marillac, reported in that year as follows :—"In Canterbury, and the other towns upon the road, I found *every English subject in arms* who was capable of serving. Boys of 17 or 18 have been called out, without exemption of place or person."* It is instructive to compare this invasion of 1539 with that threatened by the French, also from Dunkirk, in 1744, just 200 years later. The revolution of 1649 had taken place in the interval, and the English nation had adopted the creed of Individual Liberty in place of its more ancient creed of Service, the creed of the days of Cressy, expressed in the words of the motto of the Prince of Wales, *Ich dien*—I serve. Consequently, in 1744, we had hardly a trained soldier left in England to put into the field, and we were saved from immediate danger by a storm, which, whilst it favoured Admiral Norris, was contrary to Admiral Roquefeuille off Dungeness, and destroyed the French transports at Dunkirk. Later we were saved by European complications, the South German invasion of France calling Louis XV. south from Holland, and bringing Frederic the Great to his assistance.

* MS. State Paper Office, Second Series, quoted by Froude, *History of England*, Vol. III., p. 162. The French invasion of 1545 was, if Mr. Froude's account be accepted, likewise defeated partly by the territorial volunteers of Sussex, partly by weather, partly by plague. See Vol. IV., p. 138. It is not always remembered that in the 16th century we were threatened alternately with invasion by Germany, France, and Spain. Of these, the Armada alone was fairly defeated at sea.

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EFFECTIVE MILITARY ORGANIZATION AND CONTROL.

By LIEUT.-COLONEL J. A. GIBBON, R.E.

THE regulations enforcing decentralization and the chain of responsibility in units are most explicit, and few will be found who do not, in theory at any rate, agree with them. It may be useful therefore to consider why there is sometimes such a considerable difference between theory and practice in this matter, and how far it is practically possible for units serving at home to maintain an organization such as is enjoined by these regulations.

There are probably few, if any, units in which this organization does not exist on paper; that is to say, there is a nominal roll, kept more or less to date, in which each officer, N.C.O., and man is allotted to a half-company, section, or sub-section.

But organization to be effective requires very much more than this. It means that the commander of each sub-unit must be responsible in every respect for the *personnel* of his unit, and of his unit only, in the same way as the commander of, say, a battalion is responsible for his battalion.

Such an organization can exist in practice. The writer remembers some years ago hearing two Horse Artillery subalterns quarrelling in deadly earnest over a "rotten driver and pair of horses," which one accused the other of trying to "stick him with." These officers had realized what responsibility meant, and took a corresponding interest in their units. Unfortunately not many junior military officers have the advantage of such a position and training, and it may be useful to consider why this is the case.

Constant changes make the maintenance of a decentralized system somewhat troublesome; but in the case of R.E. officers this is not really serious, since all our junior officers have had sufficient training to enable them to take a command. The difficulty in the case of N.C.O.'s will be considered later.

Shortage of officers is a much greater difficulty. Where there is only one subordinate officer in a unit, the commanding officer cannot,

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except in special circumstances, or for a short time, hand over command of half his unit to his junior, while he himself has to command the other half as well as the whole; so that in this case the junior officer cannot usually have a command of a sub-unit, but must act as his superior's personal assistant; that is to say he has to ascertain his commander's ideas on every subject and carry them out, without having any real responsibility for the result.

But probably the commonest reason of all for centralization is unwillingness to face the risk of work being improperly done by others who are not considered fully competent, either from lack of experience, or from want of a sufficient sense of responsibility.

Every officer without exception likes "to have a show of his own to run," but in practice it not unfrequently appears, with junior and inexperienced officers, that they do not realize the responsibility which must go hand in hand with authority, and that they must be called to account for anything amiss in their units whether they have had direct control over it or not.

On the other hand, it is very unpleasant for a commanding officer to have to find fault with his juniors, especially if they are nearly of his own standing; while a senior officer with a keen sense of his responsibility is not unnaturally reluctant to hand over charge to one who does not fully realize his responsibility. Rather than face the difficulty of getting the work done to his satisfaction by his junior therefore he too often does it himself, hardly perhaps realizing that immediately he does this the chain of command is broken, and the system collapses. This means that the junior's work becomes limited to carrying out certain specified and therefore more or less routine duties, in other words to doing what he is told, and he finds that "he is not allowed to do anything," and his work is uninteresting.

It is not necessary here to plead in favour of effective organization. A centralized system is bound to be a failure, since it must break down directly it is tested by any practical work where the C.O. is necessarily dependent on his officers and N.C.O.'s, even though it comes sucessfully through the ordeal of a barrack square inspection. Nay more; it is in itself a failure, since the proper training of officers and N.C.O.'s is much more important than that of the men. Moreover, the C.O. himself is the one who has most to lose by such a system. No officer can hope to be really successful in the higher commands who has not learnt the art of making the best of his subordinates. This needs not only firmness, but patience, tact, knowledge of character, and above all experience. The officer who has shirked the difficulties of getting work done through others will not suddenly acquire the art in the stress of war, or when he finds himself in some position where it is indispensable.

The principles on which "Operation Orders" are based in *Combined*

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Training, lie at the root of all successful command, whether in peace or war. For instance, "orders should contain everything that a subordinate cannot arrange for himself, and nothing more."

Junior officers fail to give satisfaction at least as often, because they have no clear and definite idea of what is required of them, as they do from undue interference in matters of detail.

To make a subordinate quite clearly understand what he has to do, while leaving him free to make "his own dispositions for the purpose of carrying it out," is by no means easy, and requires both experience and clear thinking. The officer who is immersed in details which ought to be carried out by his subordinates has generally no time for this.

Few junior officers will be found who do not readily respond when their duties are put before them in the right way; but where an officer persists in abusing his liberty by doing nothing, the best remedy is not to take away the liberty, but to make him keep a diary showing exactly what he has done each day and at what times.

Another essential principle of command as laid down in *Combined Training* is that orders must always be given through the proper channel. It is necessary to emphasize this point, as in practice it often seems very troublesome to carry out.

What may be called the higher art of command, that is, the power of getting work done through subordinates, is not easily acquired by an officer, even though he fully understands how to get men to follow and obey him personally. But if this is difficult for an officer, much more is it difficult for a N.C.O.; hence, owing to frequent changes, it is seldom possible in a unit at home to make permanent effective subdivisions of N.C.O.'s commands, though this does not prevent the junior N.C.O.'s of a section or sub-section being allotted specific duties under their seniors.

There is a story of an Irishman, who explained that the reason why his landlord had not been shot was that "what's everybody's business is nobody's business"; and so it is in a unit without effective interior organization—a great many things which ought to be done, and could easily be done, both as regards discipline and training, go by default because it is everybody's business, therefore nobody's business, to do them.

Effective organization stands for effective discipline as well as effective training. Thus it follows that the senior N.C.O. of a sub-unit should always inspect his men on parade and report. Occasional inspection by the officer then suffices; but the N.C.O. who fails to report an untidy or dirty man must be dealt with drastically. The result will come as a pleasant surprise to the commanding officer who tries this system for the first time. The training of the soldier also becomes a comparatively easy matter, provided the officers and

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N.C.O.'s have a clear idea of what it is they have to teach their men, and what standards are required in the various subjects.

For instance, it is not enough that a N.C.O. should be held responsible that his men can march. It must be laid down that they have to be able to march a certain distance in a certain time without sore feet; and of course the N.C.O. must have opportunity given him of bringing his men up to that standard.

It has been said of great commanders that they possessed "the supreme merit of trusting their subordinates." Such trust is not a blind reliance on the part of the commander, but a reasonable confidence, based on experience and knowledge of character, that the task he has assigned to his subordinate will be carried out. There is a great contrast between such a commander and the officer who mistakes interference in certain details for general control, or worse still, who spends his time in doing as much of his subordinates' work as possible, and then expects them to do the rest.

Surely therefore we should not be deterred by the difficulties of, at times, getting work efficiently done through our subordinates, but should take every opportunity of trying to learn by experience how to command.

ORGANIZATION OF THE MOUNTED UNITS OF THE ROYAL ENGINEERS.

By COLONEL A. G. DURNFORD, LATE R.E.

THE following alterations should be made in the Paper on the "Organization of the Mounted Units of the Royal Engineers" which appeared in the *R.E. Journal* for October last:—

Page 235, line 27 *et seq.*, should read:—

"In 1900, during the late South African War, *three* additional Field Troops were raised—one of these was disbanded in 1902—and on the 15th April, 1907, when the Bridging Companies were reduced, two more were formed."

Page 242, *before* "*4th Field Troop* (*formed April*, 1907)" *insert*:—

4th Field Troop (*formed August*, 1900).

Capt. Ridout	1900-1902
Lieut. L. C. Jackson	1902

when the troop was disbanded.

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THE R.E. HEADQUARTER MESS.

(*Continued*).

By LIEUT.-COLONEL B. R. WARD, R.E.

Arranged in a group round the large picture of Sir John Burgoyne in the north annexe are portraits of the following four officers :— Lieut.-General William Skinner, Major-General Sir William Green, Lieut.-Colonel Sir Richard Fletcher, and Major-General Sir Henry Durand.

Lieut.-General William Skinner* (1700—1780) is the senior military engineer commemorated in our gallery of portraits. He obtained his warrant as Practitioner Engineer on the 11th May, 1719, and commenced his duties at the Ordnance Office in the Tower of London. In 1724 he was employed on the first general survey of Gibraltar, and did duty there throughout the siege conducted by the Spaniards under the command of the Conde de las Torres in 1727. In 1741, during the War of the Austrian Succession, he was appointed Chief Engineer at Gibraltar, succeeding Jonas Moore, who had been killed at the Siege of Carthagena. In 1746, after the suppression of the Jacobite rising in Scotland, Skinner was appointed Chief Engineer of North Britain, with orders to construct such defence posts as would effectually control the Highlands. He was employed for several years making surveys and plans, and in 1749 commenced the construction of Fort George, which was completed in 1753. General Wolfe, who was afterwards killed at Quebec, wrote in 1751 that the new work, which was estimated to cost £106,000, would, when completed, "be the most considerable fortress and best situated in Great Britain." In 1757 the officers of the Corps first received military rank, and Skinner was gazetted Colonel on the 14th May of that year, being the senior of a batch of 52 Engineer officers gazetted on that day, receiving at the same time the Royal Patent appointing him Chief Engineer of Great Britain. In the following year he reported to the Master-General of the Ordnance on the new defences of Gibraltar, and until his death in 1780 he was constantly employed on fortification works all over the United Kingdom. The defences of Fort George, Fort Augustus, Edinburgh Castle, fortifications at Milford, Plymouth, Portsmouth, etc., are testimonies of Skinner's

* See *Dictionary of National Biography*, Vol. LII., p. 350, and Porter's *History of the Corps*, Vol. II., p. 382.

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work. Scarcely had Skinner completed the Milford work when the Government, becoming alarmed for the safety of Gibraltar, sent him back to the Rock to make all sure in case of attack. In 1760 he was sent to Belle Isle on, probably, some secret mission, as a preliminary to the anticipated descent upon the place. In 1761 he was promoted Major-General, and in 1770 Lieutenant-General.

His long service of 61 years has probably been exceeded by Sir John Burgoyne only, and by no other officer of the Corps. He was buried in the churchyard of St. Alphage, Greenwich, where there is a stone slab to his memory. His original portrait hangs in the Convent—the residence of the Governor—at Gibraltar. The picture in the Mess is a copy of the Gibraltar portrait, and was presented in the names of his great-great-grandson, Major Thomas Skinner, C.M.G., and of the latter's son, Lieut. Monier Williams Skinner, R.E., on the 17th August, 1875.

The original device of the Corps—a soldier in classical armour with shovel and wheelbarrow—seems to have been devised by Colonel Skinner in 1757, when military rank was first granted to Engineer officers, and is given below.

The title "Royal" was not granted to the Corps till the 25th April, 1787, seven years after Skinner's death. He and Lord Heathfield are the only military engineers commemorated in our portrait gallery whose whole service in the Corps belongs to the pre-Royal epoch.

General Sir William Green, Bart.* (1725—1811), was appointed a Practitioner Engineer in 1743. He resigned the appointment of Chief Engineer of Great Britain in 1802, when old age and infirmity compelled him to retire on a pension. His war services extended over a period of 38 years, from the Battle of Fontenoy in 1745 to the

* *Dictionary of National Biography*, Vol. XXIII., p. 58, and Porter's *History of the Corps*, Vol. II., p. 391.

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end of the famous Siege of Gibraltar in 1783. In 1747 he was wounded at the Battle of Val, in Flanders, and in 1759—the year of victory—he was with Wolfe on the Heights of Abraham, on which occasion he was again wounded.

No British Engineer of the 18th century attained so much distinction both in the field and as a designer of defence works.

In 1772, when he was Chief Engineer of Gibraltar, King George III. granted him a warrant to raise a Company of Military Artificers. This step was taken on Green's strong recommendation, and marks the origin of the rank and file of the Royal Engineers. His service at Gibraltar extended over a period of *22* years—from 1761 to 1783. He was 36 years of age when he first reported for duty at the fortress, and when he left it at the age of 57 he was still the same active, energetic engineer as when he first began his reports and projects for improving the defences.

The following is General Skinner's letter forwarding Green's estimate of £50,000 for reconstructing the Gibraltar defences :—

"Greenwich, 30th August, 1770.

"Right Honble. and Honble. Gentlemen,

"In consequence of your orders, I have considered and examined Lieut.-Colonel Green's projects and reports on the present state of the works at Gibraltar, and herewith enclose my opinion and report of same. Lieut.-Colonel Green has been very exact in his account of this place. I speak by my own knowledge, there is hardly fifty yards that doth not vary in the advantages or disadvantages for or against the attacker. And I cannot help adding that an Engineer, to understand and know this place, must not only reside there for some time, but he must not be idle and remain in his quarters when there. For the man that designs to make himself master of the defences of this place must be perfectly acquainted with every rock, every precipice, and every fort and foible on the mountain, to be ready on a call for its defence, as well as a knowledge of the round or circuit of the walls. This knowledge of the mountain cannot be obtained but by great labor as well as time; the different precipices vary in their nature so very much that they may easily deceive a passenger, and appear in a very different light at first sight to what they would do on his closer examination of them, both within and without. For I do conceive, and I think I can affirm, that there is not a known place that is so peculiarly circumstanced and situated in Europe as Gibraltar is, and which with a proper garrison may be so advantageously defended."

The estimate was sanctioned, and Green had the good fortune to complete the work during the seven years of peace that followed.

At the close of his service at Gibraltar, in November, 1781, during the great siege, when the enemy opened a cave on the eastern side of the Rock, which Green had closed up before the siege, he made a personal reconnaissance to ascertain what was going on, being

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lowered down the face of the Rock several hundred feet. Evidently his 57 years sat lightly on him.

Few members of the Corps deserve or have obtained more honour than he. He was made a baronet for his services, was thanked by both Houses of Parliament, and was Chief Engineer of Great Britain in 1787, when the Corps to which he belonged, and on which his exploits and services had shed so much lustre, was granted the addition of Royal to their former title.

As the originator of the rank and file of the Corps, and as the Chief Engineer in one of the most famous sieges in history, few will deny to Green in the 18th century the position occupied by Burgoyne in the 19th century—that of the greatest Royal Engineer of his time.

Lieut.-Colonel Sir Richard Fletcher, Bart.,* K.C.H. (1768—1813), was gazetted a Second Lieutenant in the Royal Artillery on 9th July, 1788, and was transferred to the Royal Engineers on the 29th June, 1790. His war service began in the following year, and continued, with but short intermissions, until he was "killed by a musket ball at the mouth of the trenches" before San Sebastian on the 31st August, 1813.

Fletcher joined the staff of Sir Arthur Wellesley as C.R.E. in 1809, and for the next four years the name of no other Engineer officer occurs more frequently in the Wellington Despatches. In 1811 he was made a Knight Commander of Hanover, created a baronet, decorated with the gold cross for Talavera, Busaco, Ciudad Rodrigo, and Badajoz, and was permitted to wear the insignia of the Portuguese Order of the Tower and Sword.

Colonel Landmann—whose portrait is also hanging in the Mess—had handed over the command of the Royal Engineers in the Peninsula to Fletcher in August, 1808, immediately after the Battle of Vimiera.

Early in 1813 Colonel Landmann met Sir Richard Fletcher in England at a dinner party just before his return to the Peninsula as C.R.E. on the staff of the Duke. "He had already," writes Colonel Landmann in his *Adventures and Recollections*, Vol. II., page 336, "seen much more service than any other officer in the Corps of Royal Engineers. He had assisted at the capture of all the islands in the West Indies taken by us at the commencement of the great war. . . . He had been in Egypt, and I believe at Copenhagen, and had been present at most of the battles and sieges under Wellington. . . . In short, I have reason to believe that he would have had more medals than the great Duke himself."

He seems to have had a presentiment of approaching fate, for he remarked to Landmann after dinner, "The pitcher may go once too often to the well."

* *Dictionary of National Biography*, Vol. XIX., p. 319, and Porter's *History of the Corps*, Vol. II., p. 404.

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Within a month of his landing in Spain he was killed at the storming of San Sebastian by a ball from a wall-piece, which passed through his neck.

Sir Richard was buried with three other Engineer officers—Capt. C. S. Rhodes, 2nd Capt. G. Collyer, and Lieut. L. Machell—on the height of St. Bartholomew, opposite San Sebastian. The background of the picture in the Mess represents the fortress before which he fell.

A committee was formed in 1829 with a view to the erection of a monument in Westminster Abbey to the memory of Sir Richard Fletcher. Major-General Sir Alexander Bryce, C.B., was president of the committee, Colonel John T. Jones, C.B., and Lieut.-Colonel C. W. Pasley being amongst the members of the committee. Mr. E. H. Baily, R.A., was the artist selected to carry out the work in the north-west tower of the Abbey.

The circular calling for subscriptions is signed by Colonel Pasley, and closes with the following words:—"A Monument to Sir Richard Fletcher cannot be considered merely as a personal tribute to the Merits of that distinguished Individual. It is no less a Record of the Services of the Corps, of which he was the Representative in the Peninsular War; and it will be impossible to inspect it without also calling to mind the services of those Gallant Officers, by whose zeal and exertions he was so ably supported, and so many of whom fell like him, in the execution of their Duty, during that memorable Contest."

Major-General Sir Henry Marion Durand,* K.C.S.I., C.B. (1812—1871), obtained his commission in the Bengal Engineers in 1828. Lieut.-Colonel Pasley wrote of him at Chatham in the following year as being "one of the most distinguished young Engineers whom I have ever had under me, both in respect to diligence, ability, and conduct" (*R.E. Professional Papers*, Vol. XXII., New Series, p. ix.). His after-career in India was a most distinguished one, both as a soldier and civilian. His war services included the first Afghan War of 1838, the second Sikh War of 1849, and the Mutiny of 1857, when, in the words of the Governor-General, "Colonel Durand saved our interests in Central India until support could arrive."

His services as a civilian were at least equally striking. He was Private Secretary to Lord Ellenborough, the Governor-General, from 1842 to 1844. From 1844 to 1848 he was Commissioner of Tenasserim. After the Sikh War of 1849 he was appointed Political Agent at the Court of Scindia at Gwalior. From Gwalior he was transferred to Bhopal, and from thence he was promoted to Nagpore. In March, 1857, he was selected to take charge of the Central India Agency, one of the most important political charges in India. Two months afterwards the Sepoy outbreak at Meerut occurred. "The history of Sir Henry Durand's tenure of the appointment is in fact the

* *Dictionary of National Biography*, Vol. XVI., p. 244, and Porter's *History of the Corps*, Vol. II., p. 489.

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history of the Mutiny in Central India" (Thackeray's *Biographical Notices of Officers of the Royal (Bengal) Engineers*, p. 139). During the course of the year he held Indore and re-conquered Western Malwa, thus clearing the way for Sir Hugh Rose's Campaign in Central India. He was Foreign Secretary in India from 1861 to 1865, during the Governor-Generalship of Lord Canning, Lord Elgin, Sir William Denison—whose portrait hangs close by—and Sir John Lawrence.

From 1865 to 1870 he was a member of the Governor-General's Council in charge of the Military Department, and in May, 1870, he was appointed Lieutenant-Governor of the Punjab, an appointment which he held until his tragic death—the result of an accident—on the 1st January, 1871.

Lord Mayo, the Governor-General, in publicly announcing his death, said: "Her Majesty has lost a true and faithful servant, the Viceroy an able and experienced comrade, the Punjab a just and energetic ruler, and the Indian service one of its brightest ornaments" (*Dictionary of National Biography*, Vol. XVI., p. 246).

In the Mess portrait Sir Henry's great services as a civilian are indicated by his representation in diplomatic dress. His services as a soldier have also been commemorated by his brother officers by means of a medal named after him, which is annually bestowed by the Commander-in-Chief in India upon the most deserving native officer or non-commissioned officer of the Indian Sappers and Miners. The medal commemorates on the obverse a striking feat of arms in which, as Lieut. Durand, he took a prominent part in the First Afghan War of 1838. He was with Sir John Keane's column in the advance northwards to Cabul, and it fell to his lot to undertake the duty of blowing in the gates of Ghazni, an operation rendered necessary by the absence of any siege train. "Capt. Thomson, the Chief Engineer, had advised the assault of Ghazni by the Cabul gate, and Durand was selected to place the powder-bags and to fire the train. The operation was a very hazardous one. The little party had to advance without any cover and exposed to the fire from the outworks, and to approach the gate by a narrow, winding roadway, lined on each side by a loopholed wall, while the enemy were known to be on the alert. The powder—300 lbs.—was carried in bags by native sappers, a sergeant carried the hose, and Durand headed the party. On arriving within 150 yards of the gate they were discovered and fire opened on them, but pushing rapidly on they reached the gate without the loss of a man. The powder-bags were quickly laid against the gate, and Durand, with the assistance of the sergeant, laid the hose to an adjacent sally-port, where they took refuge while firing the train. The explosion was successful, the Cabul gate of Ghazni was blown in, and Ghazni fell on the 23rd July, 1839."*

* *Dictionary of National Biography*, Vol. XVI., p. 244.

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MEMOIRS.

COLONEL HENRY ROBERT MEAD, LATE R.E.

By 'H.' AND 'W.'

HENRY ROBERT MEAD—son of an eminent architect who died young—was born on the 20th April, 1836, and died at his residence, 161, Gloucester Terrace, Hyde Park, on the 9th October, 1908.

He was educated at Bath, and joined at Addiscombe in 1854. He received his commission in the Honourable East Indian Company's Engineers on the 7th December, 1855, joined at the S.M.E., Chatham, in 1856, and was appointed to the Madras Engineers, arriving in India on the 26th December, 1857.

He was appointed Assistant Engineer, Department of Public Works, on the 12th January, 1858, and remained in this Department during the whole of his service, rising through all the grades until he became, in 1887, Chief Engineer for Irrigation, and in October, 1888, Officiating Chief Engineer and Secretary to Government, which position he held until his retirement in 1889.

He married in 1875 while on leave to England.

His work was mainly in the Irrigation Branch of the Department, in which he very soon showed his talent and capacity for work, and he was, in 1864, entrusted with the important duty of investigating the conditions for the distribution of water to the various branches of the Caveri River, from which the great system of irrigation in the delta of that river is supplied. In 1866 Capt. Mead submitted his report and proposals, in dealing with which the Government expressed their "appreciation of the able and thorough manner" in which he had performed the duty entrusted to him. Most of the proposals then made were before long carried out with admirable results, but one of the most important of the proposed works, that for regulating the distribution between the Caveri and its first and main branch—the Vennar, and for excluding destructive floods from the delta, was shelved. Year after year however its necessity became more and more apparent, and Colonel Mead had the satisfaction when Superintending Engineer of the 6th Circle of seeing the Caveri-Vennar Regulator, advocated by him so many years before, taken in hand; this fine work was completed in 1886.

Colonel Mead also did excellent service in carrying out irrigation

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and navigation in the Eastern Delta of the Godavari, and on many and various public works in the Madras Presidency.

After retirement he settled in London and found ample employment in public work. He was a member of the old Paddington Vestry in 1890, and remained a representative until his death. He was an Alderman of the Borough Council from October, 1902 to 1906, and for a number of years was Chairman of the Finance Committee and Vice-Chairman of the Assessment Committee. One who was here associated with him writes : " I know how much indebted the Borough is to his sagacity, his industry, and his independence of character."

Those who had the privilege of knowing and working with him during his career would speak in the same terms. One of his chief characteristics was his hatred of humbug ; he was straightforward in everything, and the thoroughness of his character ensured work being well done, and earned him the love and esteem of those who worked with him.

Of his private life one can hardly write here ; he leaves those who will mourn his loss inexpressibly, and his old comrades and friends will miss, so long as they live, the true and honest friend who has gone before them.

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GENERAL F. H. RUNDALL, C.S.I., R.E.

By COLONEL F. M. RUNDALL, C.B., D.S.O.

GENERAL FRANCIS HORNBLOW RUNDALL died on the 30th September, 1908. He was the youngest son of the late Lieut.-Colonel Charles Rundall, of the H.E.I.C.'s Service, who at the time of his death was Judge-Advocate-General of the Madras Army. Born in 1823, he obtained a cadetship at Addiscombe in 1839, being gazetted second lieutenant in the Madras Engineers in 1841. On completion of the usual course at the S.M.E. he proceeded to India, and, in 1843, was appointed adjutant to the Madras Sappers and Miners. In 1844 he entered the P.W.D., being appointed assistant to the late General Sir Arthur Cotton, K.C.S.I., both for the preparation of the designs, and subsequently for the construction, of the great irrigation works in the Godaveri District. Pending the sanction of Government for the necessary expenditure, Rundall was ordered to the Tanjore District so as to acquaint himself with the irrigation works there. His next appointment was that of District Engineer at Vizigapatam and Ganjam, which he received in 1851, and from which he was transferred as District Engineer of the Godaveri District in 1855. Here he remained until 1859, in which year he became Superintending Engineer of the Northern Circle and Departmental Secretary to Government, and finally, in 1860, he was made Consulting Engineer to the Government of Madras for the Irrigation Canal Company's works.

In 1861 Rundall was granted special leave to act as Chief Engineer to the East India Company's irrigation and canal works in Orissa and Behar. In this capacity he designed and constructed the weirs and other large works across the Mahanadi and Brahminy Rivers, and the canals leading from them, thus successfully irrigating a part of India which had previously been frequently devastated by appalling famines. From 1866 to 1870 he was Chief Engineer for Irrigation and Joint Secretary to the Government of Bengal, and in 1871 he became Inspector-General of Irrigation and Deputy Secretary to the Government of India. Rundall was now in close touch with the great irrigation works all over India, and kept himself *au fait* in matters connected with them by personal visits of inspection.

After 30 years' arduous work in India, Rundall succeeded to "Colonels' allowances"—then termed "off reckonings," but he was still permitted to retain the appointment of Inspector-General for a further period of two years.

In 1874 he was finally transferred to the unemployed supernumerary list, on which his name appeared until the day of his death.

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Although nearly all his service was spent in the hottest plains of India, and also in most malarious districts, Rundall only once took leave to England, and that not until he had spent 20 years on end in the plains of India. In 1875 he was created a Companion of the Star of India in recognition of his services.

Only those who have seen, or have had to cope with Indian rivers, can realize the great engineering skill required to bridle and control the vast rivers such as he had to deal with, rendered still more difficult by their being subject to sudden rises and tremendous floods. Perhaps some small idea of the vastness of the irrigation work in India, may be formed by General Rundall's reply to one who criticized a Paper he once read on storing and utilizing the tidal power of the Thames. His critic politely pointed out that "The gallant general does not appear to realize that 10,000,000 gallons of water pass under London Bridge per hour." To this the General replied "We do not measure water by gallons in India, but by square miles."

In 1876 General Rundall proceeded to Egypt, at the invitation of the (then) Khedive, to examine the delta of the Nile and to submit plans and estimates for its irrigation. The details of the estimates which he submitted would of course occupy too much space for mention in the present memoir; suffice it to say that he proposed to construct a mighty dam not so very far from the site of the present one at Assouan. Nothing further was done however, as the Khedive was bankrupt and there was no money available at the time for anything in Egypt, and Rundall therefore returned to England.

In 1883 a powerful syndicate was formed to construct a Palestine canal, and General Rundall was employed to give it the benefit of his advice and valuable experience. The project was a vast one, involving as it did the introduction of the Mediterranean Sea into the heart of Palestine, the opening up to commerce of such places as Damascus and the surrounding country, and the passage of the largest vessels from the Mediterranean and the Red Sea *viâ* the Jordan Valley and the Dead Sea, and thence by prodigious cuttings and tunnels to the Gulf of Akaba. Unfortunately this project in which he was keenly interested had to be abandoned for various causes.

General Rundall was married in 1846 to Fanny Ada, daughter of Capt. William Gardner Seton-Burn, of the 3rd Light Dragoons, and resided the last 18 years of his life with his daughter, Mrs. Wingate Pearse. All his life he was a deeply religious man, and his open-handed generosity won him the deep respect and love of all who knew him, whilst his love for his Corps and his interest in its doings and all that concerned it, never flagged.

The dates of General Rundall's promotions were :—Captain, 1854; Lieutenant-Colonel, 1861; Brevet Colonel, 1868; Colonel, 1869; Major-General, 1869; Lieutenant-General, 1878; General, 1885; and, finally, Colonel Commandant of the Royal Engineers in 1876.

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MAJOR-GENERAL JOHN HERON MAXWELL SHAW STEWART.

By MAJOR W. BROADFOOT (LATE R.E.).

THIS distinguished officer died at his residence, 7 Inverness Terrace, London, W., on July 6, 1908, having nearly completed his seventy-seventh year.

Born at Springkell, Dumfriesshire, on September 9, 1831, he was the second son of John Shaw Stewart, Sheriff of Stirlingshire, and grandson of Sir Michael, the fifth baronet, whose seat, Ardgowan, is beautifully situated on the Clyde, near Greenock. The family is an old one, descended from Walter, the High Steward, and Marjory, daughter of Robert Bruce ; their grandson became Robert III., King of Scotland, in 1390, and his son, Sir John Stewart, of Ardgowan, founded the house.

The subject of this notice was but nine years old when his father died, and his guardians, prejudiced against public schools in England, sent him to a school called "The Grange," at that time popular with Scottish families, but with little apparently to recommend it as a place of education. Among his schoolfellows were Sir Mountstuart Grant Duff and Lord Macnaghten ; but the six years spent there he looked on as lost. He afterwards was sent to Bath to prepare for Haileybury, with the view of entering the Indian Civil Service ; this was given up, and, instead, a cadetship to Addiscombe was obtained on the recommendation of Lady Mary Stewart, from Sir John Cam Hobhouse, President of the Board of Control. He joined in August, 1849, and has mentioned as contemporaries Major J. A. Nutt (Vice-Consul, St. Sebastian) and Major Malcolm Paton, of the Cairnies, Perth, who retired from the Bombay Engineers in 1864.

He had however other fellow students at the College whose names are better known :—Major Pat. Stewart, an officer of great promise, identified with telegraphic service in India and Persia, and General Sir Æneas Perkins, K.C.B., A.D.C. to Queen Victoria, both of the Bengal Engineers. In the Bengal Artillery Field Marshal Lord Roberts, of Kandahar, Pretoria, and Waterford, and General Sir James Hills-Johnes, G.C.B., need no further description to military readers. In the home Royal Engineers of similar standing were Sir John Cowell, K.C.B., Sir Gerald Graham, G.C.B., and Charles George Gordon, whose name may dispense with rank and decoration. These

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form, it will be conceded, a most distinguished list of contemporaries. With two of them Shaw Stewart's name was connected—with Perkins, because of a memorable encounter at Addiscombe; Shaw Stewart and Perkins, who were excellent friends, having been chosen as representatives to settle by boxing a dispute between their terms; and with Charles Gordon, by serving on the Committee of the Gordon Boys' Home.

From Addiscombe Shaw Stewart was appointed to the Madras Engineers on June 13th, 1851, and, after the usual two years at Chatham, he joined at Madras on the last day of 1853. The following six years' service was of the usual kind, and requires no comment beyond stating that his promotion both in the Corps and in the Public Works Department was unusually rapid. He became 2nd Captain on the 24th November, 1858, and District Engineer in February of that year. Shaw Stewart had however volunteered for service during the Mutiny with the Saugor Field Force, and both the General Commanding the Division (Sir George Whitlock) and the Brigadier-General applied for him, but he was thought to be too young for so important a position, and Capt. Hemery* was appointed. In 1859 he was selected by Colonel Bell, Chief Engineer, to prepare the Code of Regulations for the Department of Public Works (Madras), and though war with China prevented its completion, he was thanked by his Government for "the diligence, patience, and ability" he had brought to the work.

Disappointed of active service during the Mutiny, Shaw Stewart's opportunity came in March, 1860, when he was ordered to China in command of the Madras Sappers with the Expeditionary Force. This formed part of a British and French armament sent to obtain redress for loss incurred near the mouth of the Peiho in the previous year. The allied force moved forward on August 12, and Shaw Stewart was present at the action of Sinho on that day, and afterwards at the capture of Tangkoo, August 14; Taku Forts, August 21; Battle of Tangchow, September 21; and siege operations before Peking in October. Lieut.-General Sir J. Hope Grant, G.C.B., the Commander-in-Chief, testified in despatches to his zeal and good service. On October 24, 1860, the treaty was signed in Peking by Lord Elgin and Prince Koon, brother of the Emperor, and the Madras Sappers returned home, having "well sustained the ancient reputation of the Corps."†

The other Engineer officers with the detachment were Lieut.

* Edward Hemery, 2nd Lieutenant, 9. 12. 1842; retired as Colonel, 25. 11. 1864; services: Aden, 1846; Mutiny, 1858. His name is next senior on the Madras list to the late Colonel J. C. Anderson, C.S.I., foremost in his day as an Irrigation Officer.

† Madras Government Order, No. 222, 18th January, 1861.

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Trail, who afterwards served in the Punjab in the accounts department (he died a Colonel in 1892); and Lieut. A. J. Filgate, who retired as Colonel in 1890, after distinguished service in the same department. Being subalterns, they had to be content with the medal and clasps for the campaign, but Shaw Stewart, in addition, received a brevet majority.

Though the story of the war and the plunder by the French troops of the Summer Palace are familiar, some extracts from letters to his family may be given; they are interesting, and testify to excellent power of observation and description. After the action of Sinho Shaw Stewart records in a letter dated August 25th:—

"I was out all the night of the 13th * * *. I had one companion with me, Major Fisher, of the R.E.; we literally felt our way along, for we could scarcely see anything. When we got to the inner ditch we heard a sentry cough, and he too seemed to have heard us, for they began to burn blue lights. We threw ourselves down, and a few shots they fired must have passed over us. When they were quiet we retired, as we had got all the information we wanted, and then began our work. It was 4.30 a.m. before we returned to camp, and at 5.30 a.m. the order was given for the advance to the assault. The attack was almost entirely an artillery one—the Armstrong guns manœuvred splendidly, and in less than two hours we were ordered forward with pontoons and scaling ladders—(I was interrupted here by a message from the General, and have not had a minute since). This left us in rear of the Taku Forts—they are eight in number, and very strong indeed, especially on the seaward side, which is almost impregnable. Every advantage, too, has been taken of natural defences, for while the sea mud and the river protect them to a great extent, on the land side numerous canals and deep ditches have been dug, which give us a good deal of bother. On the 17th I accompanied the General on a reconnaissance of the position, and the next two days I was busy getting bridges ready for crossing the Force over the ditches. On Sunday evening, the 19th, we moved out, and during the night, and the following day and night, we were incessantly employed in fixing bridges, making dams across ditches, and making batteries. We had five batteries ready by Tuesday morning, and at 5 a.m. the assault began. I had been out the whole of the two nights before, and through sheer fatigue was obliged to snatch two hours' sleep, so did not get up till about 7 or 8 a.m. There was then a very vigorous cannonading going on, and very soon afterwards the storming party was sent forward. I followed with them, and after a little we succeeded in escalading the wall, and soon the Union Jack and the Tricolor were floating from the highest point. The Tartars fought splendidly—everyone was surprised at the courage and obstinacy they displayed. Our losses were slight, 22 officers wounded, 180 men killed and wounded. French—4 officers wounded, and 90 men killed and wounded. I was twice splattered with mud by a round shot, and Sir Robert Napier had his glasses carried away while holding them to his eyes."

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Again, dated :—

"OUTSIDE THE WALL OF PEKIN,
"*25th October*, 1860.

"We marched towards Pekin on the 5th, and, after two days' wearisome toiling in quest of the Tartars without being able to bring them to any general engagement, took up our quarters in a suburb on the North side of the City. By some most unaccountable mismanagement or misunderstanding the French went on straight to the Emperor's magnificent Summer Palace, containing a collection of works of art and curiosities, European and Asiatic, certainly without a rival in the world. This they began to sack and destroy * * *. The plunder was of the richest description, indeed such magnificent property I have nowhere seen, and the dreadful and wasteful destruction of these beautiful gems of art quite went to one's heart. I suppose that such a unique collection exists nowhere in the world, and three-quarters of the beautiful collection have been ruthlessly destroyed. I rode out there yesterday and spent some hours in very sad meditation among the sack of the Palace. The pleasure grounds are beautifully laid out and do credit to the taste of the nation, said to contain the best gardeners in the world. (Here I am suddenly called out for another reconnaissance of the City). I shall not try to describe the splendours of that unique spot—it is about 5 miles from Pekin, and covers 20 or 30 square miles—the whole of which is laid out as a park and covered throughout with the most tasteful mingling of hills and water, rocks, trees, and grass, with palaces, temples, grottoes, and summer-houses scattered about everywhere, every building being furnished in the most lavishly magnificent style."

Terms were discussed, and only complied with at the last moment.

"After this we took possession of the North wall of the City, and on the 17th a message was sent to the Chinese to the effect that if a certain fine was not paid (for each of the prisoners who had been tortured and murdered) by 10 a.m. on the 20th, we would march on the immense City Palace, take it and destroy it. Again they kept us waiting till the last minute, and last Saturday, the 20th, our men had actually fallen into their ranks to march on the Palace, when we got notice that the sum demanded had been paid. So that twice within a week we were disappointed at the very last. To me, personally, it has been very tantalizing, as on the first occasion I was to have blown open the gates, and on the second I would have been Commanding Engineer, and would have led the storming party. * * *. We had a grand promenade through the City to a large Temple, which had been fitted up for the signing of the Treaty. The ceremony was a very imposing sight. The building chosen was about 4 miles from the Gate, and the Barbarians marched in force and in grand state, to the edification of the Celestials. Such a crowd of Mandarins was never before seen by Barbarian eye—there must have been at least 500—some of them were very venerable fine-looking men."

In 1862 Major Shaw Stewart came home on sick leave and next year on return to duty he was appointed Under-Secretary to the

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Madras Government in the P.W.D. He applied for the command of the Madras Sappers during the Abyssinian War, but withdrew his request at the instance of Sir Robert Napier; and he has recorded that "the post has been filled most worthily by Harry Prendergast,* who has already greatly distinguished himself in the Mutiny Campaign." In 1867 he became Consulting Engineer for Railways; and in September, 1871, when on furlough, he married Mary, daughter of Colonel Collyer, R.E., and returned next year to India with the rank of Lieut-Colonel. During 1876—78 he was employed on famine relief; his services, specially in connection with the management and control of the Madras Railway as a means of supply, were efficient and of great value. In 1883 he was appointed an additional member of the Legislative Council, and, a few days after, Secretary to the Government in the Public Works Department, thus attaining what is ordinarily the highest position open to those in his profession. He received a good service reward in 1885, and retired the following year with the rank of Major-General; in accepting the resignation the Governor in Council recorded "his very high appreciation of the service which that able and zealous officer has rendered to the State during the long period of his connection with the Public Works Department."

Major-General Shaw Stewart settled in London, joined the Paddington Vestry, in 1890, and did much useful work on it, and afterwards on the Borough Council as an Alderman. Though he seldom spoke and always briefly, he commanded respectful attention and had considerable influence; specially, perhaps, with those members, who, though not seeing with him precisely eye to eye, held their colleague in high esteem. He was on the Board of the South Indian Railway Company, latterly becoming its managing director, and was active in many charitable institutions. Thus, he was a governor and trustee of St. Mary's Hospital, a governor of the Gordon Boys' Home, on the Council of the Royal Military Benevolent Fund, for many years a director of the Royal Caledonian Asylum, and a member of the Committee of the R.E. Charitable Fund. He was a Fellow of the Royal Society of Edinburgh and of the Royal Geographical Society, on whose Council he served for a few years. His time therefore was fully and usefully occupied almost to the date of his death.

General Shaw Stewart in his younger days must have been above the average height, strong, and well built; in later years he stooped

* Now General Sir Harry N. D. Prendergast, G.C.B., whose services are varied and distinguished—Persian War, 1857; Mutiny, 1857–8, V.C., medal and clasp; Abyssinia, 1867–68, medal and Brevet Colonel; commanded British Burma Division, 1883; Upper Burma Expedition, 1885; served as G.-G.'s Agent in Baluchistan and Baroda; Resident, Mysore, 1891–2.

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a good deal, but always had a distinguished appearance, good features, and a pleasant manner. He was fond of sport, took much interest in Indian turf matters, and was for several years judge at the Madras races. He played rackets and lawn tennis in India, was a great walker, and fond of shooting. An old member of Lord's, he latterly spent much time there, to his great satisfaction.

He leaves a widow, two sons, and two daughters, and the many letters of condolence, received by them after his death from the various bodies with which he was connected, bear testimony to his good work.

The following lines by Rudyard Kipling have been suggested as fitly summing up General Shaw Stewart's character :—

"E'en as he trod that day to God, so walked he from his birth,
In simpleness and gentleness and honour and clean mirth.

o o o o

Who had done his work and held his peace and had no fear to die."

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TRANSCRIPTS.

THE MASKING OF FIELD DEFENCES.

Epitome of an article by V. Veitko in the December, 1907, number of the *Eenzhenernee Zhoornal.*

MASKING, as an auxiliary to fortification, is by no means an innovation, and some methods of masking are as ancient as the art of war itself. None the less, under modern conditions, views on this subject have considerably developed, although it is still considered as a subsidiary and not an essential branch of field engineering training.

At the present time, the Russo-Japanese War having opened discussion on various branches of military science, it is natural that this question of masking should receive some attention. Opinions appear to be divided, some maintaining that it has become so important—and is on the verge of becoming so much more important—that it deserves to be treated as a separate subject in military technical education, while others would argue that the importance at present attached to the subject is only the result of the usual enthusiasm for novelties.

Although truth is generally supposed to lie about midway between conflicting opinions, the object of the present paper is to contend that masking deserves to be raised to the status of an independent science, and, furthermore, that success in the struggle of fortification with modern firearms and against the artillery of the future, will depend not on digging, but on masking.

As a matter of fact, the reason that masking received so little attention in the past, is that trench-work has always hitherto been able to hold its own against artillery. Earth and other easily available materials were the efficient and trustworthy allies of the Engineer, who could make his defences with a light heart, well knowing that all the chances of success were on his side.

Originally defences took so simple a form that there was no necessity for special knowledge, or for specially trained experts for their construction. This necessity only arose as, by the gradual improvement of artillery, it became necessary to make the works more solid and complicated in design, the materials remaining unchanged. But as time went on it was found to be not sufficient merely to increase the quantity of materials used, but their quality had to be carefully scrutinized, until, finally, the enormous progress recently made in the development of artillery has driven the defence to the employment of such materials as concrete, iron, and steel, to burrow deeply in the earth, and use enormous parapets.

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Under these conditions, it is hardly possible to hope for many further discoveries in the search after reliable materials for defensive works, and, at any rate, the materials mentioned above already far exceed the limits of what can be expected as available in field warfare. What is more unfortunate is that whereas the limits of what is possible in field defence have thus been exceeded, the chances of further improvement in artillery are still boundless.

It remains then for us to seek out some new line for our ingenuity, and we will first study the following data, which may suggest a new departure in the methods of the defence :—

The experience of the Russo-Japanese War has shown—

(1). That no known form of field fortification—independently of the quantity or quality of materials used in its construction—is proof against artillery fire. It is true that there were casemates in the Hsipingai position claimed by their makers to be proof against the Japanese high-explosive shells ; but their roofs were covered with 10 feet of earth, resting on beams 12·25 inches in thickness, and such beams can hardly be considered as material ordinarily available in field warfare.

(2). That casemates and other works escape when it is not possible to find their range, as, for example, occurred in the case of the mortar batteries at Port Arthur.

From these premises it may be argued :—

(*a*). That it is more essential to preserve a work from view than to protect it from fire.

(*b*). That ordinary works can give protection from bullets and from splinters only, but that when a work is concealed from view, and consequently also from fire, it gives cover from shells of all kinds.

(*c*). That concealment from view (or masking), appears to be a surer means of opposing the artillery of the future than by digging.

It may be contended that these arguments tend to the disparagement of digging, but this is not the case. It is only desired to reverse the existing order of "first make a trench and then mask it" by contending that first of all a locality should be masked, and later on, if circumstances permit, it should be entrenched.

The value of masking first began to be appreciated in the Boer War, and the fact that as a science it did not at once attain its full importance was apparently due to the poverty and scantiness of existing methods. Since then the Russo-Japanese War has not only emphasized its importance, but has supplied abundant material for a thorough investigation of the subject from all points of view. We will now proceed to sift some of this material, and seek out the aims and objects which should form the foundation of this new "science" of masking.

The information at our disposal may be collected into the following groups :—

Colouring.—It is well known that during the Boer War the British carried paint with their guns and coloured their carriages to match their surroundings. At the time this action appeared to be childish, but since then times and views have changed, and no surprise was caused when, on mobilization, the Russian fleet was painted grey, and the troops were

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clothed in a colour made up of grey, yellow, and green. This had become as much a matter of necessity as it soon became for the troops to cover their fur caps with the sections of their portable tents, to make them less conspicuous from afar.

So colouring, as a means of masking, is worthy of every consideration, but, it will be acknowledged, that the question of how the colouring is to be carried out is still subject to discussion, and that existing methods are rather the result of blind imitation than of intelligent research. It may therefore be of interest to study some examples from natural history which may assist us in considering the subject.

It is well known that, in the equipment provided by Nature for assisting animals in their struggle for existence, colouring is an important item. All animals are coloured some "defensive" shade, in accordance with their manner of life, to protect them against the foes which prey upon them.

Limiting ourselves to only a few natural phenomena which seem to bear a special relation to military masking, we will quote the following:—

(1). The colouring of the various types is not identical, but is toned to the conditions of their life or to the colouring of their habitat. Thus creatures which feed on bright flowers and fruits are clothed in bright colours (butterflies, humming birds, etc.), or those which live among grass and leaves are coloured green, or those dwelling in sand or among stones, or on the bare surface of the earth are tinged with various shades of brown, yellow, and grey—in fact earth colour (as partridges, hares, lions, etc.).

(2). Animals which change their dwelling places are parti-coloured. Similarly some animals whiten in winter and become darker in summer.

(3). Some animals can even change their actual colour (cameleon).

(4). All animals are darker on their backs than under their bodies, an arrangement which counteracts the effect of the shadow cast by their bodies when sitting.

(5). All animals possess the instinct of seeking shelter under conditions which harmonize with their colouring, and of adapting themselves to the light; the art of coming out into the light under favourable conditions of day or night illumination, and of lying hid in surroundings which absorb their colouring, attains a perfection in the animal world which is worthy of our imitation.

In applying these phenomena to the masking of fieldworks, the following conditions must be taken into account:—

(*a*). The general shade of the locality.

(*b*). The colouring of local objects.

(*c*). The effect of the light.

(*d*). The object to be attained by the work which we are colouring.

As an example of (*a*), when a parapet is placed in ground covered with grass, it is generally turfed over. But this method, which seems so simple, sometimes produces the very opposite result from what is intended. When the slope of the parapet differs considerably from that of the surrounding ground, the shade of the former becomes different from that of its surroundings, and the new work is clearly visible.

When a parapet is placed in ground bare of vegetation, it is necessary

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to take into consideration the colour of the excavated earth. Thus a parapet of excavated sand appears darker than the surrounding ground, and should be covered with dry sand taken from the surface. Excavated gravel is also darker than that on the surface, while with black and vegetable soil the reverse is the case. Similarly a parapet in a cornfield would be masked not with sods, but with straw.

Instances are not wanting when the outer slopes of parapets have been dressed with the foliage stripped from the brushwood with which the inner slopes were revetted. This foliage quickly fades, and the parapet shows up as a very conspicuous black strip in the landscape. In the same way, where the general shade is variegated, the parapet should be coloured in variegated shades to match it. This is particularly necessary in the masking of large earthworks, such as redoubts, which occupy large sections of the horizon.

All this applies with equal force to the colouring of the troops. During the war various colours were recommended, sometimes yellow, sometimes green, and sometimes brown, and really all were right, as everything depends not on the colour, but on the shade of the locality in which it is applied. For this reason at times a colour is suitable and at other times it is quite unsuitable. It is unfortunately impracticable to change the colour of uniforms to match their surroundings, but this need not prevent small bodies of men, detailed for special duties, being disguised in this way to match the colouring of the localities at the time of their special action.

In the same way as animals know how to select hiding places which match their colouring, so the troops might be taught not only how to make use of local cover in the advance, but also how to select localities which best match the colour of their uniforms. But further than this, if it is sometimes worth while muffling the wheels of guns and the feet of horses with straw or rags to prevent noise, surely there is no reason why the troops should not on occasions be specially disguised with a view to concealment. But this most important question of masking *troops* does not come within the scope of this article, except in so far as it affects the masking of the fieldworks which they occupy, for of course the best efforts of the engineer in masking the works are wasted, if the troops occupying them unmask them by some article of their equipment, as for instance was the case in Manchuria with the fur caps worn by the Siberian corps.

Turning now to (*b*), the uses to which local objects may be applied are :— (i.) as points of orientation for those reconnoitring a position, a use which is repeatedly shown in the temporary names given to parts of an enemy's position, such as "One-Tree Hill," "Temple Mount," "Farmstead Field," etc.; (ii.), it is sometimes more expedient to adapt local objects for defence than to throw up separate trenches and works, and (iii.) they are frequently utilized as screens or natural masks, while many of these local objects on a position such as trees, bushes, corn, villages, etc., will considerably affect the general tone of the place, or will mark it with patches, lines, or blotches, as is the case with groves of trees, roads or canals, burial grounds or small hamlets.

Now in masking it is not only desirable to screen certain objects from

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view, but it is also necessary to prepare false objects which may attract the attention and draw off the fire of the enemy in a wrong direction; and in this counterfeiting of local objects a great deal can be done by a judicious use of paint. We propose later on to describe the preparation of counterfeit local objects by means of screens, but we will here mention that by means of colour it is possible to show up false objects and to obliterate real ones, a fact which is extremely useful when putting local objects in a state of defence.

(*c*). The effect of the light has considerable influence on the colouring of local objects, and consequently when masking for instance a parapet, it is well to consider how it stands with reference to the sun, how the brightness of its lighted-up faces may be neutralized and the depth of its shadows relieved, and to study how its lighting up is affected by local objects in its vicinity.

It is found that it is always easier to discern an object by the shadow which it casts, than by its own shape or colour, and consequently a parapet is not completely masked unless the shadows which it casts are also screened from view. This circumstance accentuates the importance of avoiding, when making a parapet, all straight lines and plane surfaces, as they cast sharp and distinct shadows.

(*d*). Hitherto masking may be said to have been merely an auxiliary to trench-work, but when it is understood that concealment is generally more effective than earth cover, not only trench-work, but all sapper training will combine in the service of concealment. Thus, if hitherto all the work on a position has been devoted to giving cover to the troops, now it will become a part of the duty of the Sapper to design works not intended for occupation by troops, but to act solely as screens and masks. Such works have not yet been included in the courses of fieldwork instruction, but in the early future, when views on masking have become more convinced, this omission will be removed under pressure of necessity.

Adaptation of Works to Match the Configuration of the Ground.—Abundant experience was obtained, during the war, in various methods of preparing the outer slopes of earthworks; some were left rough, others were neatly trimmed, and others were coloured; but it was found that nothing exposed a work to view so much as straightness and regularity in its outline. This fact can be verified from many photographs of works taken at the time.

Hitherto, in teaching the siting of works and trenches, we have limited ourselves entirely to studying the requirements of view and fire, but now this instruction is further complicated by the new and essential requirement of concealment—that a work shall harmonize in outline with the character of the surrounding country.

We will now enumerate a few examples of how works may be "made up" to match the surrounding features of the ground:—

(1). In the firing line the surfaces and slopes of works should not be regularly aligned, but on the contrary the shape of the neighbouring ground should be copied in the studiously uneven surface of the earthworks; if a trench be dug in a ploughed field the line of the trench should conform with the direction of the furrows, or if it crosses the

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furrows, the latter should be copied in grooves made over the parapet of the trench. In other cases parapets may be decorated with piles of stones, hedges, or groups of bushes, or they may be given the appearance of lengths of country lanes.

(2). Works in course of construction should be studied from the enemy's point of view, for the purpose of ascertaining how they may best be made to agree both in form and colouring with their surroundings.

(3). The salient angles of works may be finished off with shields coloured to match the general tone; the shadows may be relieved by bright colouring or hidden by screens.

(4). The outside ditches of works and even the trenches themselves, especially those without parapets, appear on level ground as dark lines, and on exposed slopes as dark stripes clearly showing the disposition of the troops, and consequently their masking is extremely important. Blinded saps have long been well known to us, and, in the Hsipingai position, it was not uncommon to see parts of communication trenches masked by light roofs of any available material painted to match the prevailing colour of the ground.

There is no reason why the ditches of fieldworks should not be similarly concealed. Such a form of light roof of brushwood need not lessen the value of the ditch as an obstacle, while it would effectively conceal it from view.

Screens.—The darkness of night is the best screen for concealing military operations. It has been widely used as such in the past, while in future wars it is probable that night operations will become the rule, and those by day the exception. Other natural masks are fog, smoke, bright light, etc.

In 1410 the badly-armed Lithuanians defeated the German knights at Grünwald by aid of a dust storm, and, similarly in Manchuria, dust played no small part in the operations.

In 1700 Charles XII. pushed his forces across to Dwina under a screen of smoke, and at Port Arthur the Japanese made a limited use of the same method.

It would probably be possible to cover an attack by throwing progressive lines of small smoke bombs.

The use made by the Japanese of screens formed of the rays of their search lights is worth recording. By placing projectors on both flanks of a working party, with their beams meeting at a point in front, a screen was formed through which the Russian lights were not strong enough to pierce.

Masks.—As the depth of excavations is increased and the height of parapets reduced, the question arises of what to do with the spare earth. The erection of dummy parapets to divert the enemy's attention and draw his fire is not new, indeed it is known to have been used successfully by the Russians against the Turks in 1828–9, and will always be popular with the troops. But masks can be made of other materials besides earth, just as they can imitate other things besides parapets. A very simple form of mask used by the Japanese was a brushwood screen shaped like a portion of a glacis, and coloured to match the surrounding

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ground. It was intended to hide from view men lying behind it, and is interesting as being the prototype of the up-to-date parapet.

Another example is the observing station made in the form of a Chinese tomb. Chinese tombs, as is well known, abounded everywhere in Manchuria, and the appearance of a few new ones in the landscape was hardly noticeable, to which fact these stations owed their immunity from destruction, though sited in most exposed places. This example is instructive, and might well be followed up by designing other forms of cover to resemble familiar local objects. The observatory resembling a tree already exists.

The Japanese made considerable use of screens built up of poles, brushwood, branches, grass, etc., or painted like the scenes of a theatre. Some they used with their artillery; but the most prominent example is the arrangement for the concealment of the approach of their troops at the Yalu, down the steep slope facing the Russian position. These huge screens were so skilfully disguised that from a distance they became completely merged in the general colouring of the landscape, and successfully concealed the troops passing behind them; in fact, the trick was not discovered until the Japanese had reached the river and begun crossing it.

To such an extent is scenic effect carried in modern war that it adds a fresh meaning to the expression "The theatre of war," and only dummy figures are required to complete the resemblance. But examples even of these are not wanting. They were used by General Jourdan when crossing the Rhine at Dusseldorf in 1795, and frequent cases of their use are said to have occurred during the Boer Campaign.

Among examples of military cunning, it is mentioned that the Japanese are credited with having placed sappers to fire powder charges and throw dust into the air, so as to mislead the Russians as to the fall of their ranging shells; to have put up and subsequently moved prominent objects which might be used as orienting points by the Russians; and to have simulated a charge, lying on their backs stamping and shouting, in the dark, during the close fighting on the Shaho in October, 1904, in order to draw a disorderly fire from the Russian outposts.

As the subject may be extended to include the wearing of foreign uniform as a disguise, giving false orders in a foreign tongue, copying foreign signals, and such like, it is plain that it permeates all branches of military science. Although the instances quoted form by no means a complete list of all methods of masking, yet it is claimed that enough has been said to convince the reader of its importance, and the necessity of its further study and of the development of a thorough system in its instruction.

F. E. G. SKEY.

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DECIMAL MONEY.

By COLONEL SIR C. M. WATSON, K.C.M.G., C.B.

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WE frequently hear it remarked that it would be very advantageous if Great Britain were to adopt a decimal system of money instead of the present system of keeping accounts in pounds, shillings, and pence. There can be no question but that a decimal system is convenient and simple for monetary calculations, and the fact that a considerable number of nations have adopted it shows that there is a good deal to be said in favour of it.

In all decimal systems amounts of money are represented in the following manner:—

a b c
l· l l

The figure "a" to the left of the decimal point is the unit of the system; the figure "b" to the right of the decimal point is the first subsidiary unit, and is equal to one-tenth of the principal unit; while the figure "c" to the right of the "b" is the second subsidiary unit, and is equal to one-hundredth part of the unit. In most foreign decimal systems the principal unit and the second subsidiary unit have definite names, but the first subsidiary unit has frequently no independent name given to it. In the French system, for example, the unit "a" is called "franc," and the unit "c" "centime," but the unit "b" is known as 10 centimes, the original name, "decime," for this unit having fallen into disuse. In the United States the unit "a" is called "dollar," and the unit "c" "cent"; the term "dime" is sometimes used for unit "b," but it is not official. In Russia unit "a" is called "rouble," and unit "c" "copeck"; while in Scandinavia unit "a" is "krone," and unit "c" is "ore."

It is evident that in any decimal system each unit must be exactly equal to the unit standing to the right of it multiplied by 10, and it is this fact that makes it difficult to apply the decimal system to British money of account.

In our present system of money of account there are two units, the pound and the penny, both of which have descended to us from remote antiquity. Not to go further back than the Norman Conquest, we find that, at that time, the unit of value was the pound weight of silver, and this was also used as the unit of account, although there was no actual coin to represent it. The pound was the old pound of 5,400 grains, which was divided into 240 pennies, these being actual silver coins, each weighing 22½ grains. There was also an intermediate unit of account

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called the shilling, which had the value of 12 pence, but was not represented by an actual coin.

The distinction between coins and units of money of account is very important, as there may be units in money of account which are not represented by coins, and, on the other hand, there may be coins which are not units of money of account. The half-crown is an instance of this, as, though it is a coin, it is not a unit of account, and has to be written in terms of two units, *i.e.*, two shillings and six pence.

The British system of money of account has remained unaltered for many centuries, whereas coins and their values have been frequently changed, and the question of introducing a decimal system of money into this country is not a matter concerning coins so much as concerning an alteration in the method of money of account, which is a much more difficult problem.

It is easy to see that it is not possible to use both the present penny and the present pound in a decimal system of money, as the latter contains 240 of the former, and there is no decimal relationship between them. One or other of them must be altered as a unit of account, but it does not follow that it must cease to exist as a coin. In this country the most important coin is the pound or sovereign, which, in its present form, was introduced in 1817, and has since then been the standard of value. The second coin of importance is the penny, which has a much longer history than the sovereign, and is so bound up with trade that any change in its value, however small, is a very serious matter. The intermediate British unit of account, the shilling, is not so important as the pound or the penny, and it may be regarded as a subdivision of the former or a multiple of the latter.

In considering any system of decimal money for Great Britain two points must be observed :—

1st. That the gold coinage must remain absolutely unaltered in standard of fineness, weight, and value relative to weight.

2nd. That the penny must be retained both as a coin and as a unit of account, and that its value must be altered as little as possible, consistently with the first principle.

But when the Parliamentary Committee of 1853 considered how a system of decimal money could be introduced, while adhering to the principle of keeping the sovereign unaltered, they abandoned the penny altogether, and proposed a system based on the pound as the unit. The pound was to be divided into 10 florins, the florin into 10 cents, and the cent into 10 mils. As there are 960 farthings in a pound, and as it was proposed to divide the pound into 1,000 mils, the latter coin would have had a value a little less than a present farthing. The system proposed by the Committee may be represented thus :—

£1.	Florin.	Cent.	Mil.
1	1	1	1

This proposal had many serious disadvantages. It gave up the penny and introduced three new units, neither of which corresponded to existing

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units. It is not matter of surprise that it met with little approval, and that no serious attempt was made to introduce it, although the florin ($\frac{1}{10}$th of a pound) had been in circulation as a coin (though not a unit) before the Committee was appointed, and has been in constant use ever since. We may take it as fairly certain that this system of decimal money will never be adopted, and perhaps the fact that it was the best that could be proposed by an important Parliamentary Committee has had a considerable effect in checking the introduction of any decimal system into this country.

It would appear however that the conclusion that the pound-mil system is the only feasible one is hardly tenable, and that it would be possible to devise a decimal system, under which the sovereign could be retained unaltered; while at the same time the penny could also be retained both as a coin and as money of account, subject to a small alteration in its value, which would not seriously affect its general use. Such a system might be formed by the introduction of a new unit of account, of which the value, as a gold coin, would be exactly $\frac{2}{5}$ths of a sovereign, and by dividing this coin into 100 pennies. As in our present monetary system $\frac{2}{5}$ths of a sovereign is equivalent to 96 pennies, the value of the penny would be reduced by $\frac{1}{25}$th part, or rather less than $\frac{1}{6}$th of a farthing. This is a small amount, and perhaps such a change in the value of the penny might be feasible without great injury to trade.

Before describing the proposed new system in detail it is desirable to consider what the new gold unit should be called, and in order to do this it is necessary to give a short *résumé* of the history of British coinage.

At the time of the Norman Conquest accounts of money were kept, as at present, in pounds, shillings, and pence, but, as I have already shown, the two former were units of account only, and were not represented by coins, the only coin being the silver penny of 22½ grains in weight. This was the $\frac{1}{240}$th part of a pound of silver of standard fineness, as the pound was at that time equal to 5,400 grains. The standard of fineness was 37 parts of pure silver to 3 parts of alloy, a standard which was maintained for many years, except for a short period during the reigns of Henry VII. and Edward VI., and is still maintained at the present day. The shilling was an imaginary coin, equal in value to 12 silver pennies.

There was no British gold coin until the time of Henry III., who, in 1257, introduced a gold penny, equal in weight to two silver pennies, and in value to 20 silver pennies. This coin does not appear to have been a success, and no further attempt was made to establish a gold coinage until the reign of Edward III., who issued a gold florin, which was shortly superseded by the noble, a gold coin having a weight of 138·46 grains, and the value of 6s. 8d. in money of account. The standard of the noble was 19 parts of pure gold and 1 part alloy, and this was afterwards known as the old standard. The weight of the noble was reduced by subsequent kings, but the standard of fineness was maintained. The noble continued to be issued until the reign of Edward IV., when it was replaced by the rial, which weighed 120 grains and was valued at 10s., and the angel, which weighed 80 grains, and was valued at 6s. 8d. These

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were both made of the old standard, which was afterwards sometimes called angel gold.

Henry VII. continued the issue of rials and angels, to which he added a new gold coin, the sovereign, 240 grains in weight and valued at £1. The silver penny had been gradually diminished in weight, and in the reign of Henry VII. was of 12 grains instead of 22½ grains. Henry VII. also introduced a silver shilling, and the reign of this king is noteworthy in the history of our coinage, as then for the first time the pound and the shilling became real instead of imaginary coins.

His successor, Henry VIII., also issued sovereigns, rials, and angels, to which, in 1526, a new coin was added, the gold crown, which was made of a new standard of fineness, and contained 22 parts of pure gold and 2 parts of alloy. This was known as crown gold or the new standard, in order to distinguish it from angel gold or the old standard. Crown gold, or, as it is sometimes called, 22-carat gold, is the standard of fineness used for British gold coins at the present time.

The first gold crown pieces issued weighed 57·36 grains, but this was considered too heavy, and, in 1544, the weight was reduced to 48 grains. In the latter part of the reign of Henry VIII. both the gold and silver coins were much depreciated in value, but they were restored to a satisfactory condition by Edward VI. and Queen Elizabeth. Edward VI. issued a silver crown for the first time, as previous to this the shilling had been the largest silver coin.

The coinage of rials ceased in the reign of James I., and of angels in the reign of Charles I., the last issue of the angel being in 1634; after this time the gold coins were sovereigns and crowns, both made of the new standard, or crown gold. By this time the sovereign had been reduced to a weight of 140·5 grains, and the crown to a weight of 35·12 grains of standard gold. Similar coins were issued by Charles II. on his succession, but in 1662, as the value of gold had risen considerably, they were both given up and replaced by a new coin, the guinea, which weighed 129·438 grains.

At its first issue the value of the guinea was fixed at £1 0s. 0d., but it rose in a short time to £1 1s. 0d., and frequently varied in value up to 1717, when it was definitely fixed at £1 1s. 0d.; the guinea remained of this value until 1817, when it was superseded by the new sovereign.

The value of the sovereign was fixed at £1 0s. 0d., and its weight at 123·274 grains, exactly $\frac{20}{21}$th parts of the value and weight of the guinea. It has never since been altered, and, having regard to the history of the subject, it would be most undesirable to make any change in British gold coinage in the future, either in standard of fineness or in weight relative to value.

As the value of the new gold unit, which it is proposed should be the unit of a decimal system of money, would be two-fifths the value of the present sovereign, its weight, as a coin, should be 123·27447 grains multiplied by two-fifths, or 49·30978 grains. This would be nearly the same as the weight of the gold crown of 1544, and having regard to the fact that the gold crown of Henry VIII. was the first coin for which the present standard of fineness was used, it would appear that the most

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suitable name for the new unit would be "crown." To adopt this name would be following the same course as was taken in the case of the sovereign; that coin was introduced by Henry VII., replaced by the guinea in the reign of Charles II., and re-introduced by George III. Similarly, it would not be unreasonable that the gold crown, first issued in the reign of Henry VIII., and given up in the reign of Charles II., should be re-introduced by His Majesty King Edward VII. This coin would also recall another interesting historical fact. As the sovereign weighs 123·27447 grains and is made of 22 carat gold, it contains 113·0016 grains of pure gold. The proposed crown would therefore contain 45·2 grains of pure gold, which is the amount of gold that was contained in the gold penny of Henry I. The coin which, it is suggested, should be the principal unit of a decimal system of money, would thus be equal in weight of pure gold to the penny of 1257, and of the same standard of fineness, and almost of the same weight as the gold crown of 1544.

Adopting the gold crown as the unit of money of account, and dividing it into 100 pennies, the proposed decimal system may be represented as follows:—

This would be in accord with the usual system of decimal money, and would be much simpler than the system of pounds, florins, cents, and mils proposed by the Parliamentary Committee of 1853.

Although the unit of money account would be the gold crown, sovereigns would continue to be used without any difficulty, as one sovereign would be equal to two crowns and a-half, two sovereigns to five crowns, and so on. But it would be advisable to coin no more half-sovereigns, as the gold crown would be too nearly the same size; for this reason, too, the crown should have its value, "One Crown," clearly stamped upon it, so as to prevent the possibility of mistakes. It might be advantageous to issue notes of five and ten crowns, making these of smaller size than the £5 note.

All existing silver coins could continue to be used under the proposed decimal system, but it would be necessary to issue a tenpenny piece and a fivepenny piece. As the shilling is $\frac{1}{60}$th part of a troy pound of standard silver, the tenpenny piece should weigh, if made exactly in accordance with the present silver coinage, 69·818 grains. This is very nearly 70 grains, and it might be better to make the coin of the latter weight, as it would then be exactly $\frac{1}{100}$th of an avoirdupois pound, and could be used as a weight. This would appear reasonable, especially as the troy pound is no longer a legal weight. If the tenpenny piece were made 70 grains in weight, the fivepenny piece should be 35 grains, or $\frac{1}{200}$th of a pound.

No change would be required in bronze coinage, as the penny, half-penny, and farthing would continue in circulation.

The following Table shows the value of existing coins in the proposed decimal system, and the manner in which they would be written:—

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Coins of Present System.	Value in Decimal System.	Written in Decimal System.
Sovereign	2½ crowns	C. 2·50
Half-sovereign	1¼ „	C. 1·25
Five Shilling Piece	60 pence	C. 0·60
Double Florin	50 „	C. 0·50
Half-crown	30 „	C. 0·30
Florin	25 „	C. 0·25
Shilling	12 „	C. 0·12
Sixpence	6 „	C. 0·06
Threepenny Piece	3 „	C. 0·03
Penny	1 penny	C. 0·01
Half-penny	½ „	C. 0·005 or 0·00½
Farthing	¼ „	C. 0·0025 or 0·00¼

It is proposed that the florin should be valued at 25 pence, so that it should be exactly equal to one quarter of a gold crown, and the double florin at 50 pence, so as to be equal to the half of a gold crown. The present weight of the florin is 174·545 grains. It would be desirable in future issues to increase this to 175 grains, so that the florin might be equal in weight to 2½ tenpenny pieces, or $\frac{1}{40}$th of a pound weight of silver.

No change would be required in bankers' weights for gold, as the 10-sovereign weight would be the weight of 25 crowns, the 20-sovereign weight that of 50 crowns, and so on.

Although the pound would no longer be used as the ordinary unit of money of account, it could still be used, if desired, in the statement of large sums, and, as I have explained, the sovereign, as a coin, would remain unaltered. The process of conversion from pounds to crowns, and *vice versâ*, would be very simple. To convert a sum of money expressed in pounds to the corresponding amount expressed in crowns, all that is necessary is to add an 0 and divide by 4; and to convert crowns to pounds it is only required to multiply by 4 and strike off the last figure. For example, £82,492 is equivalent in value to C.206,230.

The proposed unit would be convenient for the conversion of British money into the monetary systems of other nations. Taking, for example, some of the more important of these, we have the following equivalents:—

France	10 francs	equal to	1·00 crown
Germany	8 marks	„	0·99 „
India	6 rupees	„	1·00 „
Holland	5 florins	„	1·04 „
Russia	4 roubles	„	1·04 „
Japan	4 yen	„	1·00 „
United States	2 dollars	„	1·03 „
Portugal	2 milreis	„	1·00 „

Of course, the relative value of the different coins vary slightly as the rate of exchange alters, but the above Table will show that the proposed gold crown would be a very convenient unit for comparison with the monetary systems of other nations.

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The principal objection to the proposed decimal system is that the value of the penny relatively to the gold unit is reduced by $\frac{1}{25}$th part, and this is undoubtedly a serious one, but it is, perhaps, not insuperable, and to introduce a decimal system without this small change would be very difficult. If, for example, the penny was maintained at its present value, and was taken as the lower unit of account, then the higher unit, equal to 100 pennies, would be $\frac{5}{12}$ths of £1, and would have no satisfactory relationship to the sovereign, as five units would be equal to £2 1s. 8d., and ten units to £4 3s. 4d. With such a system the sovereign would practically have to be given up, and this is inadmissible. The objections to such an arrangement would be far greater than to making the new unit equal to $\frac{2}{5}$ths of a sovereign, and dividing this into 100 pennies.

But if the very small reduction of the value of the penny which I have proposed is regarded as too serious to contemplate, then the only alternative that remains is to abandon the idea of introducing a decimal system of money into this country, and to adhere to the time-honoured British system of pounds, shillings, and pence. That this would be the course preferred by many people is probable, but it would be difficult to say whether they are in a majority. One thing is certain, and that is that a system of decimal money should not be introduced without a most careful consideration of the effect it would have on the commercial transactions of all classes of the nation.

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NOTICES OF MAGAZINES.

Bulletin de la Presse.

September 15th, 1908.

The Present State of Aeronautics (*continued*).—The author discusses flying machines under the following heads:—(*c*). Helicopters *v.* Ornithopters. The conclusion arrived at is that the former offers great possibilities, and that the aeroplane of the future may consist of a combination of lifting screws and planes, such as has already been attempted by M. Bréquet. No solution of flying problems is to be looked for from a slavish imitation of bird flight, and the author draws attention to the fact that nature has provided no instance of rapid linear motion derived from a rotary impulse. It is by this means however that man has achieved such wonderful success.

Under (*d*), Gliding Balloons, the author describes in detail two types, viz., (1), the machines of Capazza—depending on the irregular lenselike shape of its envelope for gliding action, and (2), that of Malécot, who has combined a cylindrical balloon with an arrangement of planes inclined at will by means of a movable ballast car suspended below them. A feature of this type is the scope it provides for dropping explosives, etc., from the ballast car, without altering the stability of the machine.

International Law.—From the Japanese of Professor Nagao Aviga.—An interesting and detailed study of the special phases of international law, which affected the Japanese in their recent campaign with Russia. The author points out the excellent opportunity Japan had of studying such questions, from her system of attaching "legal advisors" to the field armies. The chief points touched on are:—

(*a*). The status of non-combatant belligerents, especially with reference to the auxiliary transport corps, which was organized by Japan after the China war, so as to do away with the drawbacks of hired coolie transport. This corps was formed of conscripts who fell short of the physical standard required of the combatant troops, and consequently included all classes of society. The numbers employed in the war amounted to 110,000, and, although classed as non-combatants, they were armed with a short sword for purposes of defence.

(*b*). The right of non-combatants and auxiliaries to take up arms to defend a territory or post on the approach of the enemy. This is fully discussed and conclusions given.

(*c*). The treatment of prisoners of war. Their capture, removal from the theatre of war, and subsequent disposal and administration are fully treated.

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The article ends by an interesting note illustrating the difficulties met with through the lack of any recognized manner of surrendering—a question it is naturally impossible to formally legislate for. The need of a system for dealing with large numbers of prisoners was also felt by the Japanese, and clearing units were formed after Mukden and the fall of Port Arthur to relieve the field armies of their care.

September 30th, 1908.

INTERNATIONAL LAW (*continued*).—Deals with the internment of prisoners of war in Japan; treatment of foreign officers, correspondents, etc., attached to the hostile army when captured; the Sanitary and Medical Services; the custody and burial of the dead (the Japanese dead were invariably cremated); and liberation on parole. Cases of the latter only occurred twice—the privilege being extended to the survivors of the *Varyag* and the officers of the Port Arthur garrison.

FRENCH GRAND MANŒUVRES, 1907 (with Plan of Manœuvre Area).—The manœuvres described took place between the XIIth and XVIIIth Army Corps in the department of Charente from 12th—14th September; Northern Sector, XIIth Corps; Southern Sector, XVIIIth Corps; each of two divisions and corps troops.

As an experiment the XVIIIth Corps was fed from a base at Bordeaux (100 kilomètres from manœuvre area) by means of two motor lorry convoys working on alternate days. Neither field bakeries nor supply columns accompanied the troops. Distribution was made to the regimental transport at specified "points of contact" in the manœuvre zone. Rest camps were established for footsore soldiers. Civil telegraphs only were used.

Directions to the umpires laid stress on the invisibility required of modern artillery, and also on the skirmishing formations for infantry at effective ranges. The functions of the cavalry seemed to be restricted to the *rôle* of covering the march of the army, no mention being made of their strategic use.—*To be continued.*

E.R.

JOURNAL DES SCIENCES MILITAIRES.

October 1st, 1908.

The article on machine guns is continued. During the last 25 years many attempts have been made to design a satisfactory weapon, but all designs of machine guns, having more than one barrel, failed both on account of their excessive weight and their complicated nature. First Maxim, and then Hotchkiss, invented single barrel guns, making use of the force of recoil and of the gas after explosion respectively. They also designed carriages which were not only steady, but light enough to go wherever a fully-equipped man could go.

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The Maxim has been adopted by England, Germany, and Switzerland, but, as it does not work well with the French '86 rifle cartridge, the latter country has adopted the Hotchkiss. These two guns are described in detail.

The French experiences of "The use of automobiles from a military point of view" date from 1897, when a "Permanent Automobile Commission" was formed of officers of all arms. Automobiles were first used on manœuvres in 1900, when a Scott train and a number of wagons were used by the commissariat, and also a large number of light cars were experimented with for the rapid movements of generals. Both innovations proved very successful. In 1905 there appeared (1) a motor ambulance fitted for X-ray work; (2), a light high-powered car for accompanying cavalry reconnaissances; (3), a petrol-electric wagon with a two-wheel trailer attached carrying a search light. In 1906 motor wagons were used both for carrying drinking water and for dragging 4·7 guns. Experiments were also made with cars iron-clad all round.

In the 1907 manœuvres of the 18th Army Corps 40 motor wagons were successfully used to carry provisions every day from Bordeaux to the regimental transport wagons, but in this case the manœuvres were short, the motors new and in good repair, while the drivers were picked men, and the roads were good. In the same year three Renard trains were used in the 7th Corps manœuvres with satisfactory results.

In the 1908 trials of industrial vehicles, made in bad weather, 36 entered and 24 were placed—the failures being due to axles or wheels. The War Minister has decided not to buy wagons unless they have iron back wheels.

Several motor wagons have been sent to Morocco.

In the "Military Month" the manœuvres of 1908 are considered. An occasional lack of reality is excused on the plea that they are primarily intended as a school for the high command. Also the men lose interest unless they are allowed to fire some blank occasionally, and the public expects to see something; and as it is necessary to execute movements in a few hours, which in war would take days or weeks, it is impossible to carry out such instructions as entrenching every position occupied. In war this would only mean one or two positions a day at the outside, while on manœuvres ten or a dozen might have to be occupied.

October 15th, 1908.

The article on "The Use of Automobiles from the Military Point of View" is continued. The trials made by several Powers are summarized. Italy is specially interested on account of her lack of horses, and the first trials were made in 1876 with some English-built wagons, which were used for moving the heavy guns mounted at Spezzia. Further experiments were made from 1898—1901, but without much success. They were continued however, and in 1905, 30 light cars were successfully used at the manœuvres. Two 24-h.p. wagons tried the same year were not so satisfactory. Their speed and carrying capacity fell off very rapidly on steep slopes, and nothing definite has been decided about their use. Experiments were made in 1906 with a train something like

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the Renard train, but driven by electricity, and according to the Press they were more than satisfactory.

In spite of her roads, which are few and bad, Japan has tried British, French, and American motors, and now wishes to build them herself. It is said that mechanical traction is to be installed in all the supply services.

Roumania and Russia used traction engines in 1877–8, and the latter Power used a Panhard train on the Renard system in Manchuria. Some Hanoverian motors sent out in 1905, were however of little use on account of the unfavourable country and roads.

Switzerland used motor wagons in the 1907 manœuvres, and Norway has also tried motor traction for guns.

In a further instalment of "Considerations on the Russo-Japanese War" the infantry tactics are considered. The continuous Japanese success is ascribed to the way in which the infantry advanced, never yielding an inch of ground once gained, and intent only on achieving its object.

The infantry weapons of both armies are described. The moral effect of the machine gun is said to be due to its even, steady rattle in the midst of the uneven roar of the fight.

The Japanese carried from 170 to 200 cartridges on going into action, although as early as the summer of 1904 both sides were trying to design equipment for carrying 200--250 cartridges.

The Russians generally fired volleys, which suited their national character better than the individual fire practised by the Japanese. The fire of the latter became much fiercer when the objective could be clearly seen.

The Russians opened fire at 1,500 to 2,000 mètres range when on the defensive, but occasionally would allow the enemy to come within 400—500 yards before firing on him.

A description of the attack of the Japanese 3rd and 5th Divisions at Liao-yang is given.

The typical Russian attack was in a very deep column, so that very few of the men could use their rifles. The Russians also kept far larger reserves than the Japanese.

Other articles appear on the "Marriage of Officers," urging the removal of the present restrictions; "The Commissariat in the Field"; and "Corollaries essential to the Two Years' Law."

H. L. WOODHOUSE.

RIVISTA DI ARTIGLIERIA E GENIO.

July—August, 1908.

PERMANENT MODERN FORTIFICATION, by V. Deguise, Major of Engineers, Professor of Fortification at the School of Artillery and Engineers. Brussels. 8vo. 238 pages with 14 plates.—This volume of

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more than 200 pages, with its elegant style, neatness of type, and fine atlas, is the work of a clear and lucid writer, and omits nothing that relates to the construction of modern permanent fortification. The author begins by examining scientifically the conditions requiring such obstacles as the typical and traditional ditches, and the particulars of structure of the escarp and counterscarp, and ends by a criticism on such accessories as barbed-wire entanglements and the like.

The tracing of both works and flanking defences, and the fundamental elements of fortification, are considered with complete and minute analysis, clearly showing the enormous difficulties to be overcome and the great expense attending the concealment of the caponiers—isolated or joined, of cement or metal—which, in the evolution of the art of defence, have taken the place of the retired flanks of the Italian system.

The author lays stress on the fundamental elements of the principal lines of defence, especially on the distance of the lines from the inhabited nucleus, and, by a reasonable analysis of the range of modern siege guns, he places this distance at about 7 kilomètres.

He condemns the system of frontal armoured forts, and pronounces in favour of a system which consists in separating the works to which the distant defences are entrusted, from those required for the near defences. With this idea he attributes to the surrounding forts the exclusive character of points of assistance to the lines of defence, arranging behind these lines the armoured batteries for distant action.

After noticing the quick-firing weapons of the present day, as constituting the effective means possessed by the defenders for repelling the enemy's attacks, he condemns the exclusive reliance on mechanical forts, and disagrees with those who, relying upon the deadly effect of quick-firing guns, believe that the action of the infantry can be disregarded.

All the more vital questions reflecting on the arrangement of the surrounding forts are treated in a wide and comprehensive manner, and with careful study of technical particulars. The tracing and the development of the lines of fire; the profiles, obstacles, and flanking defences; frontal action at great distances; the action of small arms in the middle and near zone; the action on the intervals of ground in front of the collateral forts; the concealment of observations; the illumination of the ground; the arrangements for the recruiting of the garrison and the artillery magazines; the galleries of communication,—all these details are specially examined, and light is thrown on many controversial questions.

In fortification nothing is absolute, this essentially practical art being, as Vauban said, "*founded exclusively on common sense and experience.*" No regular law can be laid down to assure the flanking of the intervals. Without excluding the employment of protected artillery for this purpose, it would seem that by entrusting the defence of the intervals to guns installed in pits (which may at the same time constitute the principal armament of the works), the character of simplicity is often better maintained, and this is in many ways advantageous.

These guns, placed in gunpits, have a field of fire horizontally in every

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direction, and have all the advantages of securing frontal and lateral action, that is to say they meet all the requirements of the defence without having recourse to the complicated flanking defences.

For the illumination of the ground, the author prefers movable apparatus placed outside the forts, to fixed apparatus posted at the culminating points of the forts and protected by rotating shields, his preference being due to the result of experiments.

While attributing the greatest importance to the illumination of the ground both in the intervals and in front of the forts, the author insists on the employment of flanking search lights which should be entirely concealed from view and protected from the enemy's fire. The observatories placed in selected positions should serve to direct the luminous rays of the search lights on the spots where fire should be concentrated. The zone of clearance should be designated, not from the search-light stations, but from the observatories, which, by means of optical signalling concealed from the enemy by an ingenious apparatus, maintain constant communication with these stations.

The places of recovery for the troops should, according to the author, be sufficiently numerous to locate all those constituting the garrison of the fort. The places allotted for the artillery service should comprise the magazines for loose powder, as well as those for charged cartridges and those for empty projectiles. In addition there should be laboratories, artificers' workshops, etc.

The considerations for and against the use of various kinds of magazines for black powder, powerful explosives, charged shells, etc., are fully treated.

With regard to the storing of prepared ammunition, there seems to be no doubt that the cartridges should be stored in imperviable magazines similar to those used for loose powder. The projectiles charged with black powder should however be distinguished from those containing high explosives. The former cannot be kept for very long owing to waste, and the absorption of moisture; the latter should be kept in proper laboratories specially devised in accordance with the latest methods, and by this means they can be kept in good condition for years.

In addition to the above, two further points are worthy of note, viz., the question of transportable shields for the guns and the organization of a second line, behind the principal lines of defence.

The military engineer in studying a defensive problem should have the feelings of the artist in making his plans to conform with the nature of the ground. Also the ground suitable for fortifications and the defensive dispositions of the military engineer, should always be considered with reference to the defensive requirements. This work by Major Deguise represents the scientific conditions and the best theories of modern fortification, and there can be no doubt that the same spirit of progress and the same precepts of modern requirements, should act as a guide to the studies and works of the future.

FIRING AGAINST BALLOONS.—The *France Militaire* of the 25th July states that as the natural consequence of the recent progress in aerostatics

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much attention is being paid in the German polygonal areas to the exercise of firing against balloons. It would seem that the results obtained from the fire are satisfactory both by day and by night.

The spherical balloons are towed in pairs, and can vary continually their height and velocity. At 2,000 or 3,000 mètres an aeronaut can clearly discern a column on the march or the interior of an encampment, and he would possibly be able to approach an enemy secure from artillery fire, which could not be opened without danger to its own troops.

The Germans have experimented against balloons with fire from mitrailleuses, but the adjustment of the fire so as to cause damage to the aerostat would require the expenditure of an enormous number of cartridges. Moreover a slight change of position of the balloon would require a new adjustment and a new waste of ammunition, so that it is found that the fire from mitrailleuses is only efficacious when the distance is absolutely exact.

Its use has certain advantages, as the mitrailleuse can be carried in an automobile and can assume almost any inclination. However, owing to its insufficient range, the fire of artillery against balloons will always be preferred, as the projectiles leave a visible trace which allows for the regulation and correction of the fire.

TRIALS WITH AEROSTATS.—The same journal states that during the autumn manœuvres this year several trials will be made in Germany with free balloons, and with the new military dirigible. The latter is considered of special importance. It is intended to prove that these balloons are useful not only for exploration purposes, but also offensively for observations of long duration. In the coming year the strength of the balloon battalion will be augmented.

At the next great manœuvres experiments will also be made with telephotography, radiotelegraphy, and electric search lights. Automobiles will be used on a large scale.

JAPANESE ARTILLERY IN 1908.—*Factories.*—The most important factories are the arsenals of Tokio and Osaka. The former arsenal manufactures rifles, bayonets, cartridges (10,000 a day), bicycles, tools, etc. The powder manufactories at Itabashi and Meguro manufacture cordite, and also an explosive powder similar to that used by the French. The arsenal at Osaka constructs cannon, artillery ammunition, and gun carriages.

Hand Grenades.—The Japanese have perfected this weapon which was found so useful in the last campaign. The last model is formed of an iron tube about 15 cm. in length containing 90 g. of explosive. It is joined to a wooden handle and can easily be thrown.

EDWARD T. THACKERAY.

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CORRESPONDENCE.

TERRITORIAL FIELD COMPANIES, R.E.

DEAR SIR,

The command of the 2nd (Field) Company, R.E. (Territorials), 1st London Division, has recently been given to me, and I am beginning to keenly appreciate some of the many difficulties which confront the commanding officer of a Territorial field company.

There is first of all the difficulty in getting adequate training oneself owing to the many business matters one has to attend to daily. The same difficulty also applies to the other officers of the company, and, perhaps, to a lesser extent to the men.

Another great difficulty is to attract officers and men to the company who, in their civil life, have the right sort of experience.

Then there is the question of how to make the best use of the limited time at our disposal, for both the training of ourselves and of the men, and it has occurred to me that you might be willing to encourage correspondence on some of these subjects in your *Journal*, and can, perhaps, obtain articles from regular R.E. officers as to how they would deal with the various problems which confront us.

Under the scheme for the training of the Territorial Force we are supposed to obtain perhaps six months' training after mobilization before taking part in any actual fighting. Probably some of the R.E. officers could give us some very useful hints as to the best method of using such time, and I think it would prove very useful if some outline scheme could be prepared beforehand, with the object of making the best possible use of whatever time really proved available for training after mobilization.

One thing is almost self-evident, and that is that the Territorial Engineers can never even nearly approach to the ideal as suggested in the article by Capt. E. E. B. Wilson, D.S.O., R.E., in the "Field Engineers of Our Next War," published in the August *Journal* of 1907. For this reason the commanding officers of all other units should be very strongly encouraged to train their men in elementary engineering of field-works, bridging, water supply, and field kitchens, etc.

We have recently completed our first training under the new scheme, and in my experience with the Engineers, dating back to 1900, I have never known the men work as willingly or as well as they did this year during our camp. We had every N.C.O. of the company at the training, and most of them for the fortnight, and, altogether, nearly 190 officers, N.C.O.'s, and men.

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Suggestions by experienced officers as to the number of skilled men required in a field company would be very useful, as, I take it, the problem we have to face is not quite the same as in a regular field company, where men are required to do a lot of maintenance works to barracks, etc. For instance, how many carpenters, blacksmiths, bricklayers, masons, fitters, engine drivers, electricians, etc., etc., ought we to endeavour to get in each company?

As a subscriber of some years standing to the *R.E. Journal*, I shall feel deeply obliged for any assistance given through its medium, and I have very little doubt that my gratitude will be shared by every commanding officer of a Territorial field company.

Yours truly,

JOHN H. ROBINSON,

Capt., *R.E.* (*T.*).

The Editor, *R.E. Journal*.

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RECENT PUBLICATIONS OF MILITARY INTEREST.

OCTOBER, 1908.

(*Published Quarterly*).

THE following extracts from the list compiled by the General Staff, War Office, are published in the *R.E. Journal* by permission of the Army Council.

HISTORICAL.

DUPLEIX AND THE DEFENCE OF PONDICHERRY (1748) (Dupleix et la défense de Pondichéry (1748)). By Marquis de Nazelle. 470 pp. 8vo. Paris, 1908. Librairie Honoré Champion, 5 Quai Malaquais. 6s. 8d.

This work, compiled to a great extent from hitherto unpublished documents, and from the archives of the Dupleix family, gives us a clear picture of the energy and ability of our great opponent in India, showing the difficulties with which he had to deal and the apathy of the French Government at that time. In the middle of the 18th century, of course, the struggle between French and English in India was in full swing, and victory seemed likely to incline to the side of our opponents.

THE SEVEN YEARS' WAR; A DIPLOMATIC AND MILITARY HISTORY. VOLUMES II., III., and IV. (La guerre de sept ans; histoire diplomatique et militaire. Tomes II., III., et IV.). By M. Richard Waddington. Volume II., 500 pp., with 7 maps. Volume III., 550 pp., with 6 maps. Volume IV., 640 pp., with 8 maps. 8vo. Paris, 1908. Firmin-Didot. 6s. per volume.

This is an admirable history of an interesting and engrossing war, which owes its great hold on our imagination to the brilliant exploits in which it abounds, as well as to the immense importance of the issues which were at stake. Simultaneously with the great war being waged in Central Europe, Great Britain and France were fighting for the sovereignty of two vast continents, India and North America. The prize of the struggle was a great Colonial Empire, which fell to the lot of Great Britain, whose success was, as Englishmen believe, in a very considerable measure due to the genius of one man, William Pitt.

M. Waddington does not altogether agree with this opinion. He considers it difficult for a foreigner to understand Pitt's extraordinary renown, which existed during his lifetime and has not been dimmed in the course of a century and a-half. Whilst acknowledging that he was gifted with foresight, clearness of vision, and firmness, M. Waddington goes on to enumerate various defects in his character, which appear to deprive him of the right to lay claim to a place among the great statesmen of history. M. Waddington, in fact, looks upon Pitt as a typical Englishman of the period, possessing indeed the virtues of his countrymen in a high degree, but also, to an equally great extent, their faults and shortcomings.

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BONAPARTE AND THE CONSULATE. By. A. C. Thibaudeau. Translated and edited by G. K. Fortescue, LL.D. 314 pp. 8vo. London, 1908. Methuen. 10s. 6d.

Thibaudeau's "Mémoires sur le Consulat," of which this is an excellent translation, has become so rare that this interesting work will be of special value to the student of Napoleon as a statesman. It gives a chronological table of events from November, 1799, to May, 1804, and deals fully with the period between February, 1800, when Bonaparte, as first Consul, took up his residence in the Tuileries, and 1804, when the Empire was founded.

The work consists largely of records of discussions in the Council of State, and of private conversations between the first Consul and various Councillors, all of which show clearly the foresight and genius of Napoleon in the compilation of the Code Napoleon and Consular Constitution. The Editor, in a preliminary note, gives a clear and full outline of the Constitution of 1799, and the ample notes throughout the book give useful and interesting information.

An index makes reference easy.

This work does not however contain much of interest to the student in search of military information alone.

MEMOIRS OF THE WARS OF NAPOLEON, 1806–1813 (Mémoires sur les guerres de Napoléon, 1806–1813). By General Désiré Chlapowski, Baron of the Empire (published by his sons). 370 pp. 8vo. Paris, 1908. Librairie Plon. 2s. 6d.

General Chlapowski was a Polish officer who served with considerable distinction under Napoleon, and became A.D.C. to the Emperor.

These memoirs acquire additional interest from the fact that the author was not a Frenchman, nor even very friendly to France; he served in the French Army merely because he hoped that Napoleon would effect the liberation of Poland from foreign domination. When the Emperor showed his readiness to abandon the cause of Poland, Chlapowski at once sent in his resignation and left the army. The memoirs, though written by an officer of the French Army, do not therefore show the extreme bias and partiality which so often detract from the value of such writings.

MEMOIRS OF GENERAL BENNIGSEN. VOLUME III. (Mémoires du général Bennigsen, Tome III.). By Capt. E. Cazalas, French General Staff, under the auspices of the historical section of the French General Staff. 470 pp., with 4 maps. 8vo. Paris, 1908. Lavauzelle. 8s.

The first two volumes of General Bennigsen's memoirs, translated and published by Capt. Cazalas, were highly appreciated. The value of the third volume is perhaps even greater owing to the fact that it deals with the important campaigns of 1812 and 1813.

General Bennigsen does not, in his letters, confine himself to a mere narrative of events; he indulges in frequent and able criticisms, and his remarks on the campaign of 1812 are of particular value and importance, as he does not spare either Napoleon, Alexander I., or the Russian leaders.

Among the appendices is an account of the assassination of the Czar Paul, and a biography of a number of Russian generals, containing most interesting details.

The maps accompanying the volume are good and accurate.

THE LEIPZIG CAMPAIGN, 1813. (Special Campaign Series). By Colonel F. N. Maude, C.B. 270 pp., with maps. 8vo. London, 1908. Swan Sonnenschein. 5s.

This volume, which is No. 7 of the Special Campaign Series, opens with an account of the condition and evolution of the Prussian and French Armies respectively, in which

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Colonel Maude traces the causes of the decline of the Prussian Army from the model of Frederick the Great. His chapter on the French Army is more a review of the Napoleonic methods than of the French Army as such.

Two chapters are then devoted to the prologue of the war and to the operations up to, and including, the Battle of Lützen. The next chapter deals with the operations up to the armistice, including the Battle of Bautzen. The author, in common with many authorities, blames Ney largely for the indecisive result of that battle.

The remainder of the book deals with the operations of the Autumn Campaign, culminating in the Battle of Leipzig.

The book is a strategical study only, for within the limits of 270 pages of tolerably large print it would be impossible to deal with the tactical side of a campaign which included so many engagements and battles.

Colonel Maude's conclusions, and the arguments which lead to those conclusions, can by no means always be accepted, but if the reader is content to study the account of the operations and deduce therefrom his own lessons, then the book can be thoroughly recommended, for the account of the operations is clear and the maps fairly good, though a certain number of places mentioned in the narrative cannot be found on them.

Colonel Maude uses the book as a vehicle to expound some of his pet theories, especially those of psychic force and of will power, with which readers of *War and the World's Life* will be familiar.

THE CAMPAIGN OF 1815, CHIEFLY IN FLANDERS. By Lieut.-Colonel W. H. James. 331 pp., with maps. 8vo. London, 1908. Blackwood. 16s.

Colonel James in the preface gives as the object of his book "to investigate these charges (*i.e.*, those made by German writers against the Duke and in depreciation of the part taken by the British troops), and to determine certain other questions, such as the reasons for the delay in issuing the orders for the concentration of the Anglo-Allied army, the instructions given by Napoleon to Ney on the 15th June, the cause of the Prussian hesitation on the 18th, and the formation of the Imperial Guard in its last attack."

Regarding the first point, Colonel James blames the Prussians, and especially Gneisenau, for failing to give Wellington any information as to the results of the French advance against them on the 15th. Wellington, we believe, did not blame anybody, but says "that there was certainly something out of order in the communication between the two armies in the middle of June." Colonel James also blames Dörnberg, but praises Constant and Perponcher for their action.

Colonel James also blames Gneisenau for the events of the 16th. It is stated that Gneisenau selected the ground for the Battle of Ligny himself, and that consequently he is to blame for the Prussian defeat; also that it was owing to bad staff arrangements that Bülow did not reach the battlefield.

Gneisenau again is called to task for the staff arrangements on the 18th, when the author considers that he committed an error in sending Bülow to lead the advance against the French right flank, and also in the general arrangements for the marches of the various corps. Colonel James is convinced that Blücher, thoroughly loyal to the Duke, was ignorant of the details of the arrangements made by the chief of his staff.

The account of Waterloo itself is very clear, and the comments and arguments at the end of the account are worth reading. In these Colonel James blames Napoleon and Ney for their inactivity on the 17th, and Napoleon for not using his cavalry sufficiently, while he comments on the bad staff arrangements of all three armies.

Generally the book has much to recommend it. It is written in a clear straightforward style and the operations can therefore be easily understood. It cannot be said that Colonel James brings out very much new about a campaign respecting which so much has already been written, but he would seem to have attained the object set forth in his preface. The maps are excellent. It is to be wished that the price had not been so excessive.

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THE CANADIAN MILITIA. By Capt. E. J. Chambers. 125 pp., illustrated. 4to. Montreal, 1907. L. M. Fresco. 20s.

The book traces the development of the military forces of Canada from their earliest days, and records the successive changes which have taken place from time to time in their organization and administration; at the same time the different campaigns in which the forces have taken part are briefly referred to. The author commences by describing the Militia system under the French *régime*, and then goes on to show how it was reconstituted under British rule, which dates from the capitulation of Montreal in September, 1760. The various changes in the constitution and organization of the Militia in the succeeding years are then recorded, and it is shown how the confederation of the different provinces, the grant of self-government, the Trent affair, and the part taken in different campaigns have gradually raised the Canadian forces from the level of a mere auxiliary to the regular army to the status of a powerful unit of the Imperial forces. The book concludes by giving a short account of recent developments in the Canadian Militia, and a brief description of the Department of Public Works, in so far as it is responsible for the provision of magazines, armouries, etc., for the military forces.

THE FIRST ENGLISH CONQUEST OF CANADA. By Henry Kirke, M.A., B.C.L., F.R.G.S. 224 pp., illustrated. 8vo. 2nd edition. London, 1908. Sampson Low, Marston. 3s. 6d.

The author commences with an account of the causes which led up to the war with France of 1626–29, and then goes on to describe the growth of the commercial spirit in England and the various expeditions to North America by merchant adventurers. The capture of Quebec by Sir David Kirke and his brothers in 1629, as well as the circumstances under which it was handed back to the French in 1632, is then recorded. The author at this point describes the discovery of Newfoundland and the various attempts to establish a settlement there. He concludes with a short account of the first settlement in Nova Scotia, and shows how the interests of the early settlers were entirely ignored in the treaties contracted between England and France.

MONOGRAPHS IN MILITARY HISTORY (Kriegsgeschichtliche Einzelschriften). Issued by the Historical Section of the Great General Staff. Series 41/42. Experiences of Modern Wars outside Europe. The Russo-Japanese War, 1904–5. Wa-fang-kou and preliminaries to Liao-yang. With 5 panorama sketches and 2 appendices; 11 lithographed maps in separate case. 8vo. Berlin, 1908. Mittler. 5s. 2d. with maps.

This is the third series of monographs on the Manchurian War issued by the Great General Staff in Berlin.

The first section deals with the movements of the opposing forces in June, 1904, and contains descriptions of the Battle of Wa-fang-kou and the action of Hsiu-yen (German rendering is Siu-yang).

The second section deals with the operations of the IInd and IVth Armies up to the end of July, 1904.

The third section treats of the events in the eastern portion of the theatre of war up to the beginning of August, 1904.

Section IV. contains a brief survey of the situation at the commencement of the fighting round Liao-yang.

Section V. deals with the fighting on the east of Liao-yang, August 26th to 28th.

Section VI. deals with the operations on the south side during the same period.

The narrative throughout is most clear and the maps are excellent. English students will however be puzzled by the different transliterations. The use of maps issued with reports of British attachés will consequently be found of great assistance.

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The comments of the German General Staff on the operations under review are as follows :—

The Russians during the period succeeding the fighting at the Yalu and at Nanshan were reaping the fruits of their previous omissions. They had neglected to oppose the Japanese landings, had faced Kuroki with insufficient forces, and had allowed Port Arthur to be cut off. The necessity of attempting to raise the siege of this fortress from the land side placed them in a difficult position. Every advance southward from Ta-shih-chiao exposed their communications to interruption by Kuroki or by further Japanese landings on the shores of Liao-tung, thus proving the influence that sea-power exercises on military operations near a coast line. As things stood, Kuroki must be crushed before Stakelberg's southward move could have any decisive results. An offensive movement eastward had, at that time, every prospect of success. In hill warfare the offensive has many advantages, as was shown by the advance of the Ist Japanese Army in July and August. The Russian forces available in May were however somewhat inadequate for such an enterprise. In the absence of a move against Kuroki, Stakelberg's advance must either be a half measure or if made in strength a great piece of temerity.

The operations under consideration illustrate the dependence of strategy upon the configuration of the theatre of operations. Acting on interior lines according to approved principles was impossible for the Russians, whose rear was never free. The above must be taken into account in order rightly to appreciate the Russian conduct of the war.

Nevertheless, the movement on Wa-fang-kou had some prospect of success Approximately equal forces contended for victory which for some time hung in the balance. Better tactical training on the Russian side and the timely arrival of the fresh troops *en route* might have given them the victory. Stakelberg was justified in waiting for reinforcements before pushing forward, but the disastrous effect of the half measures which Kuropatkin and his subordinates favoured is clearly demonstrated.

The Russians covered their retreats with praiseworthy skill, and the practicability of such operations in present-day warfare as demonstrated in this campaign deserves to be noted. Adopted by them with a purely defensive purpose, manœuvres of this nature may become necessary even though an offensive strategy be contemplated.

If Kuropatkin's intention was not to accept a serious battle except at Liao-yang, maintenance of touch with the enemy on both fronts (south and east) was imperative, and such touch could only be maintained by some offensive movements in the mountainous eastern region. No necessity existed however for exposing the advanced detachments to defeat in detail in prepared positions. The independent larger cavalry units, reinforced by cavalry with army corps and by some of the numerous (regimental) mounted scout detachments, should have formed the foremost line, supported by infantry bodies thrown forward.

The attraction of the prepared position of Liao-yang appears to have dominated the strategy of the Russian generalissimo. In August several opportunities for successful strokes—especially against Kuroki—presented themselves.

The exggerated idea of the Japanese strength which prevailed at Russian headquarters, which had its origin in the division of the Japanese forces into "armies," had some influence on Kuropatkin's attitude.

The Japanese had to secure what was already gained. Safe bases on the Manchurian mainland were indispensable, and considerations of foreign loans imposed additional caution. Moreover, the rains, which principally affected offensive operations, greatly retarded their movements.

The IInd and IVth Armies showed more energy than did the Ist Army. Transport and supply difficulties delayed the mobilization of the active troops remaining in Japan, and as the passive attitude of the Russians could not be foreseen, the Japanese position during this period was actually one of great risk.

MONOGRAPHS IN MILITARY HISTORY (Kriegsgeschichtliche Einzelschriften). Issued by the Historical Section of the Great General Staff. Series 43/44. Experiences of Modern Wars outside Europe. The Russo-Japanese War, 1904–05.—BATTLE OF LIAO-YANG. 127 pp.,

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10 appendices. Separate case containing 10 lithographed maps. 8vo. Berlin, 1908. Mittler. 4s. 6d. with maps.

This work is divided into six sections.

Section 1 deals with the preparations for the battle. The Russian position and the distribution of troops along it are described in detail. The Japanese dispositions are also given.

Section 2 deals with the fighting on the Russian right, August 30th—31st.

Section 3 deals with the fighting around the position Tsao-fan-tun (German rendering Zo-Fan-Tun), Ku-cheng-tzu (German rendering Kau-Tschin-Tsy), which was attacked by the Japanese Guard and 10th Divisions on August 30th—31st.

In Section 4 the fighting of the 1st Japanese Army on the right bank of the Tai-tzu-Ho on September 1st is described.

Section 5 deals with the Japanese attacks on the Liao-yang defences, September 1st—3rd.

The 6th Section is devoted to a description of the Russian retreat.

In conclusion, criticisms on the strategy and tactics of both sides are offered, the gist of which is as follows:—

The decision of Kuropatkin to accept battle was justified, but not so his dispositions. His position was liable to be turned on both flanks. Infinitely greater liberty of action would have been gained by transporting the extensive war material which was stored at Liao-yang to the north betimes, thus rendering the possession of Liao-yang city a matter of minor importance. Colonel Gädke, the well-known war correspondent of the *Berliner Tageblatt*, disagrees with this criticism on the ground that the moral effect of abandoning a carefully prepared position without fighting would have been as bad as that of a lost battle. The authors proceed to point out that the holding of Liao-yang position was an evil, in that it enabled the Japanese to concentrate their main forces against Liao-yang itself, leaving only detachments to watch the Tai-tzu-Ho, since a formidable counter-attack across that river was not to be apprehended. Such a movement was indeed impossible for the Russians; if made in considerable force below (west of) Liao-yang it exposed their army to disaster in case of failure; if made with small numbers it would have produced little effect. Upstream of Liao-yang great difficulties of ground presented themselves. Considering the above factors, it would have been better to concentrate the main force around Lotatai (some 8 miles N.E. of Liao-yang) in readiness to attack the enemy when he crossed the Tai-tzu. A measured resistance on this river would have exhausted the assailants prematurely. Here, again, Colonel Gädke joins issue with the Great General Staff. The cautious Japanese, says he, would in such a case have merely pushed a weak advanced guard across the Tai-tzu to construct a bridge-head at Hsin-cheng (N.E. of Liao-yang), the rest of the army remaining south of the Tai-tzu, whilst a renewed forward movement was being planned. The Lotatai position, too, would have been susceptible to a turning movement, as are, in fact, all positions. In the opinion of the authors, Kuropatkin should, assuming the necessity of defending the position actually chosen, have provided for an active defensive instead of guarding his flanks and rear with disproportionately large forces. The reserves were frittered away in reinforcing his passively defensive line of battle by driblets, instead of acting offensively against the enemy's flanks. The absence of offensive spirit was likewise noticeable amongst subordinate Russian commanders. When Kuropatkin finally decided upon attacking, two courses are considered to have been open to him—

1. To attack the exhausted enemy on the South bank of the Tai-tzu with his main force whilst warding off attacks from the North bank.
2. To fall with all available forces upon that portion of Kuroki's army which had crossed the Tai-tzu whilst holding the bridge-head at Liao-yang.

(1) Promised the greater results in case of success, but failure would have meant disaster. The plan adopted was akin to (2), and whilst promising less decisive results, kept a secure line of retreat open. In executing his plans Kuropatkin is held to have handicapped himself by opposing to Kuroki's force troops exhausted by previous fighting

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The authors declare that on September 3rd there was still a chance of success for the Russians—a firm will was however required. The dispositions for retreat are praised, but their successful execution is ascribed largely to the exhaustion of the Japanese. The latter are considered to have entered upon the battle in an unfavourable position owing to the concentric movements by which their armies had pursued the retreating Russian detachments, whom they vainly endeavoured to destroy piecemeal. Nothing except a frontal attack remained, since extensive movements to a flank were impossible so close to the hostile positions. It is questioned whether attempts at strategical outflanking movements would have been feasible or advisable before the commencement of the advance on Liao-yang. Such manœuvres would have entailed changes of communications which were more or less precluded by the mountains, and by the fact that their adoption would have debarred the Japanese from utilizing the Ying-kou branch railway. Regarding the battle, Nozu's failure to force the hostile centre is held to illustrate the difficulties of "wedge" attacks under modern conditions. Kuroki's employment of the Guard is criticized, but the tenacity with which he maintained the fight north of the Tai-tzu is appreciated.

Oyama's decision to keep back one and a-half divisions of the Ist Army when this army attacked the south bank of the Tai-tzu with the idea of using them to molest the Russian retreat is found fault with. In view of his numerical inferiority, all available forces should have been employed. The zone of the Ist Army should have been prolonged westward, and other portions of the Japanese line correspondingly altered, the 4th Division attempting to envelop the Russian right.

The necessity of an attack against the south of Liao-yang after the Ist Army had fought in vain for two days is doubted. A concentric attack from both banks of the Tai-tzu by the Ist and IVth Armies would have obliged the Russians to face Kuroki with weaker forces. Meanwhile the IInd Army should have guarded against a Russian eruption southward from the Liao-yang defences and secured the flank of the IVth Army.

Officers studying these maps will find British official maps of great use in helping to identify places, since the German spelling of Chinese names differs greatly from ours.

POLITICAL.

INDIA. PARLIAMENTARY BLUE BOOK, CD. 4201. Papers regarding:—I. Orakzais. II. Zakka Khel Afridis. III. Mohmands. 1908. 168 pp. 4to. 1s. 6d.

Part I. deals with the request of certain Orakzai clans to be taken under British administration. A despatch from the Government of India sets forth the reasons for and against such an extension of our responsibilities as would be involved. A similar case in 1894 is quoted; and in conclusion the Secretary of State declares that H.M. Government adhere to the policy of non-interference laid down in 1898, and therefore decline to accede to this request.

Part II. begins with the settlement effected with the Khyber Pass Afridis in 1898: relates the various offences committed by the Zakka Khel. The Government of India advocate permanent occupation of the Bazar Valley, and ask sanction for an expedition for the purpose. The Secretary of State objects to a policy of occupation, and only sanctions the expedition, subject to a time limitation, and no occupation or annexation. Then follows the correspondence regarding the formation of the force, and the operations, and the Political Report on the expedition.

Part III. begins with the relations entered into with the Mohmands in 1896, as a result of the Durand Agreement. Then follow the events of April, 1908, which led up to the recent expedition; the serious situation in the Khyber at the beginning of May, the incursion by Afghans, and their dispersal; the formation of the Mohmand Field Force, its operations, and their successful conclusion.

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NAVAL.

THE NAVAL ANNUAL, 1908. By T. Brassey, A.I.N.A. 437 pp., with numerous plates and diagrams. 8vo. Portsmouth, 1908. Griffin. 10s. 6d.

This year the *Naval Annual* is divided into four parts.

Part I. contains a review of last year's work in British and Foreign Navies, with comparative strength and tables; and chapters on Foreign Naval Manœuvres, the armoured cruiser question, Marine Turbines, the *personnel* of the French Navy, the second Peace Conference and Naval Interests, the share of the Fleet in the defence of the Empire, and the Naval and Maritime Industries of Italy.

Part II., as before, contains lists of British and foreign ships, with plans.

Part III. contains Armour and Ordnance Tables.

Part IV. contains the First Lord's Statement, the Navy Estimates, programme of ship building, and returns of gunlayers' tests and battle practice; the Navy Estimates of Austria-Hungary, France, Germany, Italy, Russia, and the United States; and Sir E. Gray's Instructions with Sir E. Fry's Report on the Hague Conference.

Among the contributors are Admiral Sir Cyprian Bridge, Sir F. Pollock, and Mr. J. Leyland, and among these the attention of soldiers is specially drawn to Admiral Bridge's article on the share of the Fleet in the Defence of the Empire.

The volume fully sustains the high standard of its predecessors.

STRATEGICAL AND TACTICAL.

TACTICS (Taktik). Vol. I. By von Balck. 4th edition. 420 pp., with numerous plates and diagrams, and an index. 8vo. Berlin, 1908. Eisenschmidt. 8s. 6d.

The author's views are founded avowedly on the German regulations, but the latter are compared at every step with those of other countries, especially of Russia and Japan.

The first chapters deal with minor tactics, equipment, and the effect of firearms, with comparative tables from various countries. The remainder consists of tactical treatises, similar to those in von Löbell's Jahresberichte for 1907, the resemblance of language in many cases suggesting a common authorship.

The following is a summary of the author's views on some of the points touched upon.

The moral endurance of troops has diminished. Losses of one-third, or even one-fourth, will no longer be endured. The close fighting, which formerly resulted in such heavy losses, has grown rarer. But individual units may be exposed to losses quite as severe as in former wars.

Formation in depth is still indispensable, and increases in proportion with the numbers engaged.

The average number of rifles required per 1,100 yards of front are estimated at:—For passive defence, 820 rifles, or ·8 rifle per mètre. For active defence, allowing for 20 per cent. casualties and a reserve of one-third, 2,400 rifles, or 2·4 rifles per mètre. For the attack, allowing for 50 per cent. casualties and a reserve of 2,000, 4,200 rifles, or 4·2 rifles per mètre (pp. 203, 204).

Close reconnaissance on the battlefield is indispensable to avoid the danger of surprise by fire at close ranges; reconnaissance in force will often be necessary. The formation of special units for the work of reconnaissance is suggested.

Machine guns are essentially a reserve of fire; it is a waste of their mobility to commit them to prolonged fire fighting. In the attack they may be pushed forward at the outset, and subsequently withdrawn. In the defence their normal position is with the reserve, whence they may be detached to threatened points. The fire of a machine gun is equal to 50—60 rifles.

The advance of infantry through their own artillery should take place at successive points, so as not to interrupt the fire too long in any one portion. Infantry must study the formations which make ranging most difficult for the enemy's guns. Small columns,

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on a narrow front, with wide intervals, are the best. (Diagrams pp. 275, 277). The attack of shielded artillery by infantry fire will seldom be worth attempting.

The battle of encounter being in the nature of a surprise, the commander must at once seek to gain the initiative by offensive action. *In every battle of encounter* after the first contact a pause ensues ; it is then that the commander must decide whether he will pursue the initiative he has gained or break off the attack.

The Japanese attacks up to the Battle of Wa-fang-kou were on the approved German model, but after that battle the superiority of the Russian artillery led to modifications in form, especially as regards depth and extension. The first step in the attack must be to feel the enemy's front all along with advanced troops, supported by artillery. Meanwhile the army moves up to a preparatory position ; with large forces this period may extend over several days. The infantry can no longer await the issue of the artillery duel ; the danger, indeed, arises that the infantry may push home the attack before superiority of fire is gained.

Flank attacks are preferable to frontal, but some element of surprise is almost essential for their success, and this can only be obtained if the holding attack is energetic. Envelopment is easier when it follows naturally from the converging advance of two separate forces, than when it is developed from a formation in depth. The necessity for the assault is insisted on ; a position can never be won by fire alone ; but fire superiority must be gained before the assault is delivered.

Entrenching in the attack is viewed with disfavour by the author, as tending to diminish the offensive ardour of the troops.

The Russians in Manchuria used advanced positions, defending them obstinately against superior numbers, with the result that the main position had often to be abandoned without fighting. In France and England advanced positions are much favoured, but rather to mislead the enemy, and to afford opportunities for counterstrokes.

The difficulty of executing the counterstroke lies in the choice of the moment for launching it ; it cannot be foretold how long the enemy will take to get within striking distance. The reserve can however be moved gradually towards the position as the enemy gets nearer. The commander will need great strength of character to refuse appeals for reinforcements as the crisis of the battle approaches. As regards *direction*, frontal counter-attacks appear hopeless in theory, but the experience of war shows that they are often successful.

The following tables, etc., are of interest :—pp. 51—63, infantry formations in various countries; pp. 68, 106, 113, 147, 232, tables showing effect of fire ; p. 159, trajectories and shape of ground ; p. 162, casualties ; pp. 184—189, deployment of infantry ; pp. 236--246, machine-gun equipment and formations ; pp. 362—3, trenches and profiles ; p. 410, ammunition supply.

THE DECISIVE BLOW (Le coup de massue). By Dr. J. Auboeuf, with a preface by Paul Déroulède. 192 pp., with 4 diagrams. 8vo. Paris, 1907. Lavauzelle. 2s. 6d.

This is an interesting discussion of the prospects of a war between France and Germany, which the author seems to regard as inevitable. He believes that the two nations will be left to fight out the campaign by themselves ; though he has a high opinion of the fighting value of the British troops, he considers their numbers to be too insignificant and their organization too defective for them to be capable of exercising any real influence on the great struggle between France and Germany. He looks upon the violation of Belgian territory as highly probable, almost certain, in fact, but does not think that the Belgian Army will be able or willing to offer any serious resistance.

The book is carefully and ably written and is worth reading. The comparison between the French and German Armies shows a partiality to the former, and the author's conclusions may therefore be somewhat optimistic. At the end of the volume however Dr. Auboeuf confesses that the question of *moral* is all-important, and that without confidence and self-reliance France will again be crushed. His object is to show Frenchmen that their prospects of defeating Germany are extremely hopeful, and that, provided their *moral* is equal or superior to that of their enemies, they should now be in a position to avenge Sedan and march to a new Jena.

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TRAINING AND EDUCATION.

FIELD TELEPHONES FOR ARMY USE, WITH AN ELEMENTARY COURSE IN ELECTRICITY AND MAGNETISM. By Lieut. E. J. Stevens, R.A. 110 pp., with illustrations. 8vo. London, 1908. Crosby Lockwood. 12s.

The explanation of the principles of electricity and magnetism is simple, though not always quite accurate. No explanation is given of the method of testing a battery with detector.

Little detail is given about line work. Three of the Service field telephones are fully described—the new C Mk. II. is not described at all. The action of the vibrator call (called a buzzer) is very inadequately explained.

No mention is made of the necessity for separating earths at a point where several telephones are in use to avoid cross-talk.

On the whole, a useful little book, though the system of stringing hints together in the "Summaries" is confusing. The index is somewhat inadequate.

FORTIFICATION AND MILITARY ENGINEERING.

TECHNICAL INSTRUCTION FOR THE AUSTRO-HUNGARIAN PIONEER TROOPS. PART 8. BRIDGING MATERIAL AND BRIDGING TRAIN (Technischer Unterricht für die k. u. k. Pioniertruppe. 8. Teil. Kriegsbrückenmaterial und Train). Official publication. 84 pp., with 13 plates bound up separately. 8vo. Vienna, 1908. k. k. Hof und Staatsdruckerei. 2s. 6d., including plates.

This book contains a detailed description of the Austro-Hungarian pontoon equipment and of the vehicles of the pontoon train. The excellent diagrams add much to its value.

PERMANENT FORTIFICATION AT THE PRESENT DAY (La fortification permanente contemporaine). By Major V. Deguise, Professor of Fortification at the Belgian School of Artillery and Engineering. 250 pp., with an atlas containing numerous plates and diagrams. 8vo. Brussels, 1908. Joseph Polleunis. 16s.

This volume deals with the progress realized and the improvements attained in the art of permanent fortification in recent years, especially since the Siege of Port Arthur. The author has the advantage of considerable experience, and this, together with the great pains which he has taken, has resulted in the production of a most useful work—clear, thorough, and complete. The book is highly valued in France, and has been well reviewed by French military journals.

AERIAL NAVIGATION.

THE EMPLOYMENT OF CAPTIVE AND FREE BALLOONS AND AIRSHIPS FOR MILITARY PURPOSES (Fesselballon, Freiballon und Motorluftschiff in ihrer militärischen Verwendung). From the "Vierteljahrshefte für Trüppenführung und Heereskunde, 1908, Volume III." By Major Sperling, attached to the Prussian Balloon Battalion. 24 pp., with 2 diagrams in text and 5 maps. 8vo. Berlin, 1908. Mittler.

The author gives a general sketch as to the employment of the three forms of aerial conveyance in war. He holds that the experience gained in the use of captive and free balloons at manœuvres is, for all practical purposes, equal to that to be gained under

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Service conditions, but he admits that his ideas as to the employment of airships are drawn from mere conjecture.

The *rôle* of captive balloons is reconnaissance both near and tactical; free balloons and airships can combine the maintenance of communication with reconnaissance duty, which, in their case, will be distant and strategical.

The height to which a captive balloon can rise depends on the atmospheric conditions and the weight of the rope. The kite-shaped balloon, as used on the Continent, is more easily manipulated and is steadier in a high wind than its spherical British prototype; reconnaissance therefro n is consequently facilitated. The higher the captive balloon rises the less the eye of the observer has to penetrate the vapour, which clings to the earth's surface to a height of 500 mètres. A diagram is given to demonstrate this.

Except in cases of urgency, captive balloons must never ascend within range of artillery fire; there is no danger, in the author's opinion, from rifle fire. Information is easily and rapidly transmitted by telephone from the balloon to the ground.

The control of free balloons is only possible, so long as the ballast carried lasts, by ascending or descending so as to catch favourable currents of air. The airship is capable of absolutely controlled movement by reason of its motor power and steering planes. Communication from these types of aerial conveyance can only be satisfactorily carried out with wireless installations, or, in the case of airships, by returning to earth.

The writer goes on to say that the use of airships by two opposing forces must result in an engagement between the dirigibles in the air. The victory will remain with the airship which can ascend to the greatest height, and so destroy the other by showering explosives upon it.

He paints a picture of how airships may be employed in naval warfare. In reconnaissance they will precede the cruiser scouts, in the fight they can assist by destroying the enemy's ships with explosives, and could be used to tow heavily-charged torpedoes through the water, in order to make more sure of hitting the objective. Their assistance in helping to raise the blockade of a port will be valuable.

Four examples of the use of captive balloons at different manœuvres, with details of information supplied by them, are given.

The article is instructive and worthy of study.

MEDICAL.

THE HYGIENE OF FRENCH BARRACKS. AN HISTORICAL STUDY (L'Hygiène du Casernement Français. Étude historique). By J. Lambert des Cilleuls. 88 pp. 4to. Lyons, 1907. Rey. 1s. 6d.

This pamphlet is a thesis written by a student at the Army Medical School, Lyons, for his doctorate in medicine. It is of interest in giving details and facts connected with the general development of hygiene in the French Army from the earliest days to the present time. The author considers that there were three periods in the evolution of hygienic principles in barrack construction. The first period was the 17th century, when soldiers were first placed in barracks instead of being billeted on the people. The illustrious engineer, Vauban, was concerned then in the construction of barracks, and appears to have effected several reforms by his criticisms of the manner in which soldiers were housed. Amongst some of the provisions laid down at that time was the necessity of having beds large enough for two soldiers to sleep in. The second period was the 18th century and first quarter of the 19th century. It is a period in which military hygienists began to make their voice heard with sufficient authority to influence the acts of government. In the third period, which followed, the general sanitary condition and construction of barracks were reorganized in accordance with more modern scientific knowledge of the causes and prevention of disease, and by the persistent efforts of military and civil medical men and engineers. The pamphlet is useful, as a work of reference, to those interested in the history of barrack construction in France.

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ORGANIZATION AND ADMINISTRATION.

MODERN ARMIES AND THEIR STAFFS (L'armée moderne et les états-majors). By Pierre Baudin. 270 pp. 8vo. Paris, 1905. Chapelot. 3s.

This book deals mainly with the question of national defence, with special reference to that of France.

In connection with the two-years law in France, the author points out the tendency of every democracy to endeavour to lighten its burdens; at the same time he emphasizes the vital necessity for a nation to secure its national safety from invasion by another Power. Two things must therefore be considered—the demands of peace and the necessities of war. It is the task of the Government to make these harmonize, and to obtain a solution which guarantees the safety of the nation whilst ensuring the prosperity of the community.

The author deals with the staffs of the different Continental armies, comparing them, and showing the great value of a competent General Staff. He is inclined to consider the German General Staff as the most efficient and the one most adapted to the national character.

In a final chapter he discusses the growth of the German Navy and the naval programme of Germany.

A TERRITORIAL ARMY IN BEING. By Lieut.-Colonel C. Delmé Radcliffe and J. W. Lewis. 132 pp. 8vo. London, 1908. Murray. 1s.

Beginning with a preface by Lord Roberts on the subject of National Service, this book gives interesting details of the training and conditions of service in Switzerland and Norway.

The systems of universal training in these two countries appear, according to statistics furnished by large employers of labour, to be carried out with very little interference with trade and commerce.

REGULATIONS FOR TRANSPORT SERVICES BY RAIL AND SEA. PART II.—TRANSPORT BY SEA IN PEACE TIME (Regolamento sul servizio dei trasporti per ferrovia e per mare. Parte II.—Trasporti per mare in tempo di pace). Official. 77 pp. 13 plates under separate cover. 8vo. Rome, 1908. Voghera Enrico. 1s. 3d.

These Italian regulations deal very fully with all details regarding the movement by sea of troops and stores, including the duties of the embarkation staff, the vessels best suited for transport services, and the preparations required to adapt them for the work, embarkation, interior economy on board, and disembarkation.

The plates illustrate the manner in which the accommodation on transport vessels is to be utilized, the arrangement of horse stalls, and the method of slinging horses and vehicles.

BOOKS OF REFERENCE.

THE IMPERIAL GAZETTEER OF INDIA. 3rd edition. Official. Published under the authority of His Majesty's Secretary of State for India in Council. Twenty-six volumes of 400 to 570 pp. each, with numerous maps. 8vo. Oxford, 1908. Clarendon Press. £5.

As an authoritative standard work of reference for general information about India, the *Gazetteer* is of considerable military value.

This third edition was taken in hand in connection with the census of 1901, and the changes that have been introduced make it practically a new work.

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The first four volumes give general information about the Indian Empire under the headings :—

1. Descriptive.
2. Historical.
3. Economic.
4. Administrative.

Every volume is prefixed by introductory notes on Transliteration, Money, Prices, Weights and Measures. Each of the first four volumes ends with an index.

The parts of the first four volumes which are of special military interest are as follows :—

Volume I.—Descriptive.

The chapter on "Physical Aspects" by Sir Thos. Holdich, beginning with a description of the physical characteristics of the Indian borderlands.

The chapters on Ethnology, Religion, and Population, supplementing one another, give general information about the peoples of India, and to some extent supply a want that will be felt by military readers of special *Gazetteer* articles on the fighting races. The *Alphabetical Gazetteer*, for instance, has only three or four lines on "Afridis," and no articles on "Dogras," "Gurkhas," "Jats," "Marathas," etc. Further accounts of several of the fighting races are found in Chapter XIV. of this volume, and in the chapter on the "Army" in Volume IV.

Volume II.—Historical.

The latter part is more particularly of military interest. It deals with the Muhammadan invasions of India and the story of the Mughal Empire in Chapter X., and the Maratha Wars in Chapter XII. Chapter XIII. gives the history of European rivalries in India from the advent of the Portuguese up to the consolidation of the British East India Companies at the beginning of the 18th century, and Chapter XIV., the history of British rule from the struggle with the French for supremacy up to the succession of Lord Minto to the Viceroyalty in 1905.

Volume III.—Economical.

Chapter VII. deals with the development of the Indian Railway System from the purely economic point of view, and the latter part with the development of a system of roads from the time (1833) when the main roads were in the charge of Military Boards in each Presidency. Chapter VIII. traces the development of Posts and Telegraphs, and refers to their use for military purposes, and mentions the installation of wireless telegraphy between Burma and the Andamans.

Volume IV.—Administrative.

The first chapter, on "The Government of India," gives a short history of the gradual extension of British rule over India, and traces the development of the present system of the Government of India in all its branches, including the Army Department and Military Supply Department. It is to be regretted that the account of Army Organization stops short at the formation of the three commands, Northern, Eastern, and Western, in 1904, and neither here nor in the chapter on the Army has it been brought up to date so as to show the present organization in two armies, the Northern and the Southern.

The chapter upon Native States traces British relations with the Native States from the first alliances made with them by the East India Company against the French, recounts the changes in British policy with regard to them, and explains their present status.

The chapter on Foreign Relations relates how the sphere of the Foreign policy of the Indian Government has gradually been regulated with regard to that of the Home Government ; and describes relations with Southern Arabia, the Persian Gulf, Turkish Arabia, Persia, Afghanistan, Kashgaria, Tibet, China, and Siam.

The chapter on "The Army," from material contributed by General Sir Edwin Collen, is divided into (i.) the Presidency Armies under the Company, (ii.) the Armies of India under the Crown, and (iii.) Unification of the Armies and present Military Organization.

It traces the rise of the Presidency Armies from their origin as guards for the East India Company's early settlements up to the Mutiny of 1857, the causes of which are well explained. The history of the New Army up to its reorganization by Lord Kitchener is

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then told. A description of auxiliary forces is added, Volunteers, Imperial Service Troops, Frontier Militia, Levies, and Military Police, and some account is given of the Armies of Native States, including those of Nepal and Afghanistan. An appendix gives an account of the Royal Indian Marine.

The chapters on Medical Administration and on Surveys are both of military interest.

In the volumes of *Alphabetical Gazetteer* the full articles upon the different Presidencies and Provinces are worthy of notice. Each contains a paragraph upon the Army.

TRAVEL AND TOPOGRAPHICAL.

PERU. By C. Reginald Enock, F.R.G.S., with an introduction by Martin Hume. 350 pp., with a map and 72 illustrations. 8vo. London, 1908. T. Fisher Unwin. 10s. 6d.

This is a most interesting and excellent volume, practically the standard work on Peru. The author first reviews the past history of the country, and then proceeds to discuss its present condition and prospects. There are valuable chapters on the political and social systems of Peru, her climate and geology, means of communication, agriculture and natural products, mineral wealth, financial, industrial, and commercial conditions; the whole work is elaborated with considerable care, the result of some years of travel and research.

Special interest attaches to the author's remarks on the influence and prosperity of the European colonies in Peru; it would appear that German merchants and German shipping are making rapid progress, and that our own countrymen find considerable difficulty in keeping their lead.

KELANTAN; A STATE OF THE MALAY PENINSULA. By W. A. Graham. 140 pp., with maps and numerous illustrations. 8vo. Glasgow, 1908. James Maclehose & Sons, Publishers to the University. 5s.

This is an interesting handbook, well compiled and admirably illustrated. As its author holds office as Resident representing the King of Siam at the Kelantan Court, the contents of the booklet should be accurate and reliable.

In view of the negotiations now being carried on between Great Britain and Siam, the geography of the Malay Peninsula has assumed an increased importance. The author gives us a great deal of general information, especially with regard to the trade and resources of the State; its mineral wealth would appear to be considerable, whilst its capacity for rubber production is believed to be very great. The Rajah of Kelantan has already made large concessions of his territory to speculative syndicates, chiefly for rubber production.

MISCELLANEOUS.

HOW FAR HAVE THE CONDITIONS FOR SUCCESS IN WAR CHANGED SINCE 1871 (Inwiefern haben sich die Bedingungen des Erfolges im Kriege seit 1871 verändert), from the "Vierteljahrshefte für Truppenführung und Heereskunde," 1908. Vol. III. By General of Infantry von Blume. 51 pp. 8vo. Berlin, 1908. Mittler.

Changes in everything appertaining to war, during the 37 years in which Germany has enjoyed peace since 1871, have done much to alter the conditions for the tactical handling of troops in future battles. The author points, in the first instance, to the enormous growth of armies of various States since the year in question, and shows, for example, that whereas in 1871 supplies had only to be provided for a total German armed strength of 1,183,389, at the present day they would have to be arranged for a force of over $4\frac{3}{4}$ millions, and for other Powers in proportion.

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Apart from the question of supply, the mobility of such enormous forces, as compared with the smaller armies of the past, will be much affected ; greater space will be occupied ; and the development of war material and the increased destructive power of explosives become influential factors. All these things have tended to alter the conditions of fighting.

The increase in accuracy, range, and rapidity of loading of firearms, and the use of smokeless powder, have produced entirely new tactical methods. Each side now seeks to conceal itself from the opponent before and during a fight, and the battlefield itself presents a barren aspect, which only tends to increase the difficulties of the leaders as regards appreciating the situation, making their decisions, and handling their troops. The battle commences with the opposing forces widely separated, and deployment takes place earlier than heretofore ; an action is consequently of longer duration.

In discussing the tactical values of the combatant arms the writer lays stress on the fact that infantry is still the arm *par excellence*, which now prepares success in open daylight by its fire effect, and secures victory by the use of the bayonet at the moment of assault only.

He enters at length into the influence on the combat of the higher leaders, of entrenching in the field, of the constant use of night operations, of modern artillery fire effect, and of the increased independence of the cavalry. He shows how, in spite of the deadly effect of modern firearms, casualties in war have decreased instead of increased. For although in the four great battles of the Russo-Japanese War the Russians lost 16·7 per cent. in killed and wounded, and the Japanese 20·4 per cent., and although the Germans in 1871, in the 18 great battles of the campaign, lost only 7 per cent. of the forces engaged, still the four battles alluded to above lasted 40 days, whilst the 18 battles in 1871 lasted only 27 days ; thus, calculating on an average for one day of battle only, the losses to the Russians, Japanese, and Germans may be said to have been 1·7, 2, and 4·7 per cent. respectively.

Again, in the 14 days' fighting at Mukden, the Russians only lost 19·3 per cent., whilst in the one day at Mars la Tour the Germans gained their victory with a loss of 22 per cent..

Special mention is made of the use of balloons for reconnaissance purposes. These will be of use more particularly to the defence, which will thus be able to counteract the value of surprise to the superior forces of the attack. This advantage will be greatly enhanced, the writer says, when it is possible to destroy the approaching enemy with explosives hurled from above.

General von Blume concludes his article with an estimation of the cost of modern campaigns. From the fact that the Manchurian War cost Russia £230,250,000 and Japan £121,200,000, he calculates that a year's war will cost Germany £300,000,000.

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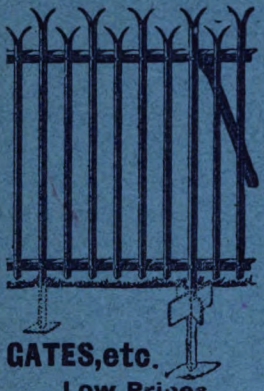

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,, J. Knowles, 15th Hussars.
,, C. R. Newman, Royal Field Artillery.
,, P. E. Lewis, Royal Field Artillery.
,, M. H. C. Bird, Royal Garrison Artillery.
,, A. F. U. Green, Royal Garrison Artillery.
,, C. G. Fuller, Royal Engineers.
,, G. R. Frith, Royal Engineers.
,, T. C. Mudie, Royal Scots.
,, I. L. B. Vesey, Royal West Surrey Regiment.
,, H. G. A. Thomson, Royal Warwickshire Regiment.
,, E. T. Humphreys, Lancashire Fusiliers.
Capt. D. S. Robertson, Royal Scots Fusiliers.
,, H. L. Alexander, Dorsetshire Regiment.
Lieut. A. P. Wavell, Royal Highlanders.
Capt. H. C. Johnson, D.S.O., King's Royal Rifle Corps.
,, R. M. Tyler, Durham Light Infantry.
Lieut. A. J. McCulloch, Highland Light Infantry.
Capt. L. C. Sprague, Royal Irish Rifles.
Capt. L. F. Renny, Royal Dublin Fusiliers.
Lieut. C. M. Davies, Rifle Brigade.
Capt. R. D. Barbor, Army Service Corps.
,, C. L. Norman, M.V.O., Indian Army.
,, G. L. Pepys, Indian Army.

The following obtained nominations:—

Major S. R. Kirby, 6th Dragoon Guards.
Capt. R. Hutchison, 11th Hussars.
,, E. F. Calthrop, Royal Field Artillery.
,, and Bt. Maj. A. J. Turner, Royal Field Artillery.
,, and Bt. Maj. C. B. Thomson, Royal Engineers.
,, and Bt. Maj. A. J. G. Moir, Royal Scots.
,, and Bt. Maj. A. McN. Dykes, Royal Lancaster Regiment.
,, A. D. Green, D.S.O., Worcestershire Regiment.
,, T. H. C. Nunn, D.S.O., Royal West Kent Regiment.
,, H. L. Knight, Royal Irish Fusiliers.

WOOLWICH.

June, 1908.

THIRD	G. B. Stallard	7,629
22nd	L. F. Page	6,564
23rd	G. E. W. Franklyn	6,559
29th	G. A. Cammell	6,437

November, 1907.

THIRD	F. N. M. Mason	7,441
FIFTH	E. J. Moorhead	7,236
SIXTH	C. W. R. Tuke	7,166
24th	J. R. Pinsent	6,493
27th	H. W. Crippin	6,411
32nd	L. H. King-Harman	6,372
35th	R. B. Pargiter	6,339

This is the second time in two years we have passed THREE out of the first SIX for Woolwich.

SANDHURST.

June, 1908.

FOURTH	H. T. Rohde	5,307
27th	W. G. Maxwell	4,937
44th	H. L. Mood	4,775
45th	H. S. F. Cosens	4,761
79th	J. M. Ponsford	4,473
89th	B. H. Bonham-Carter	4,399
105th	L. B. Rundall	4,312
127th	J. A. Batten-Pooll	4,183
161st	A. E. Lawrence	3,985
162nd	M. Alexander	3,981
167th	R. W. Russell	3,940
171st	G. W. Mackintosh	3,897
191st	R. H. Broome	3,733
—	C. S. Hilton*	3,563
—	W. N. Shipster*	3,221
—	J. V. Dawson*	3,148

*Subsequently admitted.

INDIAN POLICE, JUNE, 1907.

THIRD	F. W. Toms	6,886	27th	H. W. Waite	5,980

ARMY QUALIFYING, SEPTEMBER, 1908.

NINE were successful from us.

MILITIA COMPETITIVE EXAMINATION, MARCH, 1908.

Douglas Scott, Kent Artillery.
D. G. Gunn, 3rd P.W.O. West Yorkshire Regt.
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